CITY OF ATLANTA

Kasim Reed
Mayor

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DEPARTMENT OF PROCUREMENT
Adam L. Smith, Esq., CPPO, CPPB, CPPM, CPP
Chief Procurement Officer
asmith@atlantaga.gov

March 17, 2014

Dear Potential Proponents:

Re: FC-7272, Land Lease(s) for Solar Generating Projects

Attached is one (1) copy of **Addendum Number 1,** which is hereby made a part of the above-referenced project.

For additional information, please contact Mr. Wendell Bryant, Contracting Officer, at (404) 330-6127 or by email at wambryant@atlantaga.gov.

Sincerely,

Adam L. Smith

ALS/wamb

cc: Ms. Denise Quarles
Juanmanuel Garcia-Sanchez, Esq.
Ms. Ruthie Norton

ADDENDUM NO. 1

This Addendum No. 1 forms a part of the Request for Proposals and modifies the original solicitation package and any prior Addenda as noted below and is issued to incorporate the following:

1. Attachment No. 1: Response to 39 questions;
2. Attachment No. 2: Revised Exhibit A; Scope of Services;
3. Attachment No. 3: Cascade Road Landfill (CRLF_Caps_Specs);
4. Attachment No. 4: Gun Club Landfill (GCL_Guideline);
5. Attachment No. 5: GCL_QA_Manual;
6. Attachment No. 6: GCLF_Caps_Spec;
7. Attachment No. 7: Key Road Landfill (KRLF_Caps_Specs);
8. Attachment No. 8: CASCADE_TOPO;
9. Attachment No. 9: GUN CLUB _TOPO;
10. Attachment No. 10: KEY ROAD_TOPO; and
11. Attachment No. 11: Airport Utilities (03-11-14)-100' Scale.

Addendum No. 1 for **FC-7272, Land Lease(s) for Solar Generating Projects** is available for pick-up in the Plan Room: City Hall, 55 Trinity Avenue, Suite 1900.

Proposals are due on <u>Monday, March 24, 2014</u> and should be time stamped in no later than <u>2:00 p.m.</u> and delivered to the address listed below:

Adam L. Smith, Esq., CPPO, CPPB, CPPM, CPP
Chief Procurement Officer
Department of Procurement
55 Trinity Avenue, S. W.
City Hall South, Suite 1900
Atlanta, Georgia 30303

****All other pertinent information is to remain unchanged****

Acknowledgment of Addendum No. 1

Proponents must sign below and return this form with proposal to the Department of Procurement, 55 Trinity Avenue, City Hall South, Suite 1900, Atlanta, Georgia 30303 as acknowledgment of receipt of this Addendum.

This is to acknowledge receipt of **FC-7272, Land Lease(s) for Solar Generating Projects** on this the _____ day of _____, 20__.

_____
Legal Company Name of Proponent

_____
Signature of Authorized Representative

_____
Printed Name

_____
Title

_____
Date

Attachment No.1

1. Will the City support significant Ad Valorem Tax abatement with Fulton County for the improvements made at each parcel?

   ANSWER: Not applicable. These properties are not taxed because they are owned by a government entity.

2. Will the City accept bids that provide a lease cost lower than the indicative cost for the airport parcels if bidder can provide a pro-forma financial analysis of the property that provides evidence that a lower price should be accepted?

   ANSWER:

   The City is required to lease City-owned land for at least fair market value. Therefore, the selected winning Proponent(s) will be required to complete an appraisal of the land to be leased within 120 days of notification of award. Proponent is required to submit a cost proposal using the form provided in the RFP, amounts to be based on the Proponent's considerations. The Final Annual Lease Payment amounts will be based on the Cost Proposal or the Appraisal Value, whichever is greater.

   AMENDMENT TO EXHIBITS A-3, A-4, A-5, A-6, and A-7: DELETED.

   AMENDMENT TO EXHIBIT A: The Proponent(s) shall cover all expenses for the design, installation, maintenance, and replacement of solar panels for the farming of solar electricity at one or more of the five (5) sites listed above and in more detail in. The Proponent(s) shall provide, at its own expense, a professional land survey of the land to be leased, an appraisal of the land proposed on any of the five (5) sites and legal description to the City within one hundred and twenty (120) calendar days from the date of the Notice of Award letter. The parcel(s) of land to be surveyed shall be approved by the City prior to the survey. The Proponent(s) will be responsible for all interconnections and documentation with utility through final start-up and approval. Proponent(s) shall both illustrate and guarantee by invoice statements from Georgia Power Company that solar energy shall be sold as electricity.

3. Should multiple bids be accepted from the same bidder, will the City accept aggregate bonding and liability insurance certificates for all parcels for the same bidder?

   ANSWER: Yes.

4. Will the City amend the contingencies to add: a) Contingency in the event that a bid is selected by Georgia Power, however, electrical interconnection facilities prevent reasonable economic benefit for all parties; and b) Contingency if detailed soil and environmental engineering reports make the project economically infeasible.

   ANSWER: Yes. See Amended Scope of Services, which is attached.

5. Is it allowable for a company submit as a Prime?
   ANSWER: Yes. However, please be reminded that a prime bidder can only be a part of one team at the prime contractor level (i.e. it is illegal to bid as a JV partner on multiple teams).

6. Is it allowable to submit as a Joint Venture?
   ANSWER: Yes. However, no M/FBE or SBE participation credit will be granted to a member of the Joint Venture participant.

7. Can a sub be on more than one response to the RFP?
   ANSWER: Yes, a firm may participate on more than one bid at the subcontractor level. However, a firm can only participate on one bid at the prime contractor level.

8. Will multiple firms be selected under this solicitation to submit the same airport site(s) to the Georgia Power Advanced Solar Initiative?
   ANSWER: No. One proponent will be awarded per site at the Airport.

9. If we submit a proposal for all sites available, are we evaluated on each site separately?
   ANSWER: Proposals can be submitted either as individual projects, one portfolio of projects, or both.

10. Can we receive the latest topographic map of each site? What is the slope of the parcels?
    ANSWER: Drawings are provided. The Airport Parcels are sloped at approximately 28 degrees.

    See attached documents:
    - Attachment No. 3: CASCADE _TOPO
    - Attachment No. 4: GUN CLUB _TOPO
    - Attachment No. 5: KEY ROAD_TOPO
    - Attachment No. 6: Airport Utilities (03-11-14)-100' Scale

11. Please provide any other plans or maps of the sites.
    ANSWER:
    See attached documents:
    - Attachment No. 7: Cascade Road Landfill (CRLF_Caps_Specs);
    - Attachment No. 8: Gun Club Landfill (GCL_Guideline);
    - Attachment No. 9: GCL_QA_Manual;
    - Attachment No. 10: GCLF_Caps_Spec; and
    - Attachment No. 11: Key Road Landfill (KRLF_Caps_Specs).

12. What voltage are the lines feeding into the substation at the airport sites?
    ANSWER: 115kV at the airport. The voltage is unknown at the landfill sites.

13. What is the incline slope of the airport parcel?
    ANSWER: See Airport Parcel Drawing. The Airport Parcels are sloped at approximately 28 degrees.

14. What are the contents under the crust/cap?
    ANSWER: Municipal solid waste.

15. How much is there (i.e. volume in total and at different depths over the site)?
    ANSWER: Cascade Road- 1,714,167 cubic yards; Key Road- 4,033,333 cubic yards; Gun Club Road – 2,235,999 cubic yards.

16. What is the history/age of the waste in place?
    ANSWER: City of Atlanta residential waste from late 1960's to 1993.

17. What have the responsible parties done to close it?
    ANSWER: All Landfill have been properly closed and capped according to the Georgia Rules and Regulations for Landfill post closure care.

18. How has it been closed or capped?
    ANSWER: Yes, the all landfills received closure certificates in either 2000 or 2001.

19. What method was used to cap?
    ANSWER: Clay on the slopes and GCL- geosynthetic clay liner on the top and 6 to 12 inched below clay cap on the slopes.

20. Is there road access for installation of the PV arrays and ongoing O&M?
    ANSWER: There are no access roads to the airport parcels. The proponent will have to propose the construction and O&M strategies for the airport parcels.

    There is an access road around each landfill site. Most sites have terrace to access the different areas of the landfill.

21. Are there traffic restrictions or, typically, restrictions on heavy equipment?

    ANSWER: Yes there are restrictions and requirements for traffic and heavy equipment. RFP Exhibit A: Scope of Services describes that the proponent must obtain encroachment for working on the utilities easements; Exhibit D: Airport Security Requirements, and Exhibit D-1 describes Construction Safety in reference to traffic plans and heavy equipment.

    There are no neighborhood traffic restrictions at the landfill sites. Heavy equipment can be used to install panels at the landfills but not as a permanent structure.

22. Will the placement of the system alter the drainage swales or storm water run offs and are we allowed to alter these patterns?

    ANSWER: The proponent is responsible for the design and making sure there are no alterations. The design must be presented to DOA P&D Engineering for review as noted in Scope of Services.

    EXHIBIT A- Scope of Services states that "The Proponent(s) is responsible for the maintenance and repair of the PV system(s) as well as maintaining the integrity of the landfill cap and Airport land under and around the solar panels."

    Any item permanently placed on a landfill can possibly alter the route of runoff. Any alterations to storm water run off that significantly impacts the landfill cap and Airport Parcels is the responsibility of the Proponent to maintain.

23. Is there ANY protected environment or species to be concerned about and are they identified?

    ANSWER: None identified.

24. Is there a gas collection system on site or bleed to atmosphere?

    ANSWER: Each site has a gas collection system

25. Was there a previous land lease of the airport parcels and landfills? If so, please provide copies.

    ANSWER: There have been no previous land leases of the Airport Parcels nor the landfill sites.

26. Was there an appraisal done on the airport parcels and landfills? If so, provide copies.

ANSWER: Appraisals are the responsibility of the Proponent(s). See Exhibit A:

AMENDMENT TO EXHIBIT A: The Proponent(s) shall cover all expenses for the design, installation, maintenance, and replacement of solar panels for the farming of solar electricity at one or more of the five (5) sites listed above and in more detail in. The Proponent(s) shall provide, at its own expense, a professional land survey of the land to be leased, an appraisal of the land proposed on **any of the five (5)** sites and legal description to the City within one hundred and twenty (120) calendar days from the date of the Notice of Award letter. The parcel(s) of land to be surveyed shall be approved by the City prior to the survey. The Proponent(s) will be responsible for all interconnections and documentation with utility through final start-up and approval. Proponent(s) shall both illustrate and guarantee by invoice statements from Georgia Power Company that solar energy shall be sold as electricity.

27. What mechanism was used to provide lease amounts on airport parcels?

ANSWER: The Airport has established a per square foot land value for land inside of the Airport Layout Plan (ALP) of roughly $1.24 psf. This value has been established and validated through a number of appraisals of various facilities and is the rate all tenants are currently paying for land. The two parcels are approximately 344,124 sf.

The City is required to lease City-owned land for at least fair market value. Therefore, the selected winning Proponent(s) will be required to complete an appraisal of the land to be leased within 120 days of notification of award. Proponent is required to submit a cost proposal using the form provided in the RFP, amounts to be based on the Proponent's considerations. The Final Annual Lease Payment amounts will be based on the Cost Proposal or the Appraisal Value, whichever is greater.

AMENDMENT TO EXHIBITS A-3, A-4, A-5, A-6, and A-7: DELETED.

AMENDMENT TO EXHIBIT A: The Proponent(s) shall cover all expenses for the design, installation, maintenance, and replacement of solar panels for the farming of solar electricity at one or more of the five (5) sites listed above and in more detail in. The Proponent(s) shall provide, at its own expense, a professional land survey of the land to be leased, an appraisal of the land proposed on any of the five (5) sites and legal description to the City within one hundred and twenty (120) calendar days from the date of the Notice of Award letter. The parcel(s) of land to be surveyed shall be approved by the City prior to the survey. The Proponent(s) will be responsible for all interconnections and documentation with utility through final start-up and approval. Proponent(s) shall both illustrate and guarantee by invoice statements from Georgia Power Company that solar energy shall be sold as electricity.

28. Can you provide engineering studies on the landfills?

ANSWER: See Attached documents:

- Attachment No. 7: Cascade Road Landfill (CRLF_Caps_Specs);
- Attachment No. 8: Gun Club Landfill (GCL_Guideline);
- Attachment No. 9: GCL_QA_Manual;
- Attachment No. 10: GCLF_Caps_Spec; and
- Attachment No. 11: Key Road Landfill (KRLF_Caps_Specs).

29. Can you please provide insight regarding the status of the revenue associated with this project—has the City of Atlanta had any negotiations with Georgia Power regarding the rates that they will pay for electricity generation? If not, has the city at least been able to garner a commitment to purchase the electricity that will be generated?

ANSWER: The City has not had any negotiations with GA Power regarding the sale of electricity.

The GA Power Advanced Solar Initiative (GPASI) selection process is as follows: "To be considered for participation, applications must be completed, including all necessary attachments, and submitted online through PowerClerk between March 26 and April 4, 2014. If completed applications exceed program capacity limits Georgia Power will conduct a lottery with PSC oversight to ensure transparency and fairness for all applicants."

"Approved by the Georgia Public Service Commission in November 2012, the Georgia Power Advanced Solar Initiative (GPASI) is an innovative solar energy purchase program that will contract for 210 megawatts (MW) of solar capacity by the end of 2014. GPASI was primarily designed with the goal in mind to spur economic growth within the solar community in Georgia while offering pricing that encourages more renewable development and avoids any upward rate pressure and reliability impacts to Georgia Power customers."

More information about GPASE can be found on the GA Power website: http://www.georgiapower.com/about-energy/energy-sources/solar/asi/advanced-solar-initiative.cshtml

30. Are there any REC's associated with this project? If so, who will have ownership of these?

ANSWER: The Proponent retains ownership of all RECs. The City of Atlanta only leases the land.

31. What are the terms of the land lease agreements associated with this project; when are they due—monthly or quarterly, what are the terms, fixed or flexible?

ANSWER: Proponent is responsible for proposing lease terms and at a fixed or flexible rate. See EXHIBIT A – Scope of Services:
"The term of the lease agreement between the Proponent(s) and the City shall be for a minimum of 20 years, paid annually;"

32. Do you perceive there being any additional charges emanating from the City of Atlanta associated with the launch of this project beyond the land lease?

    ANSWER: Permits, inspections, etc. are the responsibility of the proponent.

33. Since some of the potential sites for consideration are landfills, what would be "our" access to these sites upon project completion in order to perform routine maintenance and/or service to the solar array? Additionally, will there be any consideration or rebates given if soil preparation is required in order to make the land suitable to support a solar array?

    ANSWER: Access is granted as needed. No.

34. Are teaming agreements and/or joint ventures permitted for this project? Also, will the City of Atlanta require that certain companies form a JV in order to respond or are we free to select our own partners, if desired.

    ANSWER: Joint Venture agreements are permitted for this project. Joint ventures are not required, but certainly permissible if the Proponent desires to submit such an offer to the City.

35. Will an organization be considered if they possess all of the requisite qualifications up to and including financial, insurance, technical certification in solar design, and meets the minimum tenure in solar industry if they do not have a solar project completed?

    ANSWER: No. The minimum requirements listed in Exhibit A-2 are as follows: "The Proponent(s) is required to list five (5) completed and commissioned PV Installation sites completed by the Proponent(s) within the last five years with the name and contact information of a person still employed at such sites to contact as a reference. The projects should be similar in size and scope to the project specified in this RFP."

36. Are there any connection agreements in place with Georgia Power in order to connect the solar arrays generated from this RFP to their power stations, if so, what are the cost associated with using their grid; if not, what assurances and/or allowances will the city provide to ensure that we will be able to distribute the electricity generated herewith?

    ANSWER: No agreements exist.

37. I accumulated a number of questions pertaining to the Bid, the Landfill locations and the Airport locations. However, in order for me to move forward I must question the requested lease payments for the airport sites. With all due respect, the payments are hundreds of thousands of dollars higher than any experienced and bankable solar project developer could bear for this portion of the project. Simply put, this cost will prohibit the airport portion of the project being completed, and I would question anyone that would say otherwise. Can you please explain how the economics of the minimum airport Furthermore, If the airport or city decided to base the award to the highest lease payment bidder alone, they risk awarding the project to a company that is not experienced with such projects. Please let me know if I can assist you in understanding the economics of these projects further so you may better understand the opportunity for a land lease and I look forward to your response.

    ANSWER: Please see the answer to question 27. At present, the FAA requires that the airport recover "fair market value" when leasing land and facilities within the airport boundaries and the current rate is $1.24 per sf. We recognize that the solar installation is unique in nature to other airport facilities and are willing to have a discussion with the FAA regarding adjusting this rate after the responses to the RFP have been received.

    The City is required to lease City-owned land for at least fair market value. Therefore, the selected winning Proponent(s) will be required to complete an appraisal of the land to be leased within 120 days of notification of award. Proponent is required to submit a cost proposal using the form provided in the RFP, amounts to be based on the Proponent's considerations. The Final Annual Lease Payment amounts will be based on the Cost Proposal or the Appraisal Value, whichever is greater.

    AMENDMENT TO EXHIBITS A-3, A-4, A-5, A-6, and A-7: DELETED.

    AMENDMENT TO EXHIBIT A: The Proponent(s) shall cover all expenses for the design, installation, maintenance, and replacement of solar panels for the farming of solar electricity at one or more of the five (5) sites listed above and in more detail in. The Proponent(s) shall provide, at its own expense, a professional land survey of the land to be leased, an appraisal of the land proposed on any of the five (5) sites and legal description to the City within one hundred and twenty (120) calendar days from the date of the Notice of Award letter. The parcel(s) of land to be surveyed shall be approved by the City prior to the survey. The Proponent(s) will be responsible for all interconnections and documentation with utility through final start-up and approval. Proponent(s) shall both illustrate and guarantee by invoice statements from Georgia Power Company that solar energy shall be sold as electricity.

38. Can a Letter of Credit be substituted for the requested Warranty Bond?

    ANSWER: Yes, as long as the letter of credit is good for 1 year from completion/acceptance of the project or for some other specified ime as requested by the City.

39. Is the bid bond amount based on % of Total Year 1 Lease amount proposed, or % of Total Construction Costs?

    ANSWER: It should be based on the total construction cost.

Attachment No. 2: Revised Exhibit A; Scope of Services

EXHIBIT A; SCOPE OF SERVICES

LAND LEASE FOR SOLAR GENERATING PROJECTS AT CITY OF ATLANTA LANDFILLS AND AT HARTSFIELD-JACKSON ATLANTA INTERNATIONAL AIRPORT

Background

The City of Atlanta ("City") is seeking proposals from private or public entities interested in leasing land from the City for solar farming purposes (the "Project").

The City intends to lease the space at one or more properties that include three of the City's closed landfills and two at the Hartsfield-Jackson Atlanta International Airport ("the Airport") for the purpose of solar farming (i.e., generating renewable energy using photovoltaic ("PV") panels). The City has identified Cascade Road Landfill, Gun Club Landfill, and Key Road Landfill as potential landfill locations and two parcels on the south side of the security identification display area ("SIDA)" at the Airport for the Proponent(s) to construct solar panels and to harvest solar energy – these sites are un-shaded areas that are currently underutilized. All projects on Airport Parcels I and II will coordinate with Atlanta's Department of Aviation (DOA) and projects on one or more of the landfills will coordinate with Atlanta's Department of Public Works (DPW).

The Proponent(s) must be capable of building and maintaining solar equipment that have a minimum capacity of 800 kW per project on the following sites:

- Cascade Road Landfill (11 acres available);
- Key Road Landfill (23 acres available);
- Gun Club Road Landfill (38 acres available);
- Airport Parcel I (3.92 acres); and
- Airport Parcel II (3.98 acres).

Conservative estimates show that a total of 5 MW of solar power could be built on the available land, generating an estimated 7,000 MWh of electricity annually.

Objective

Leasing underutilized land for the purpose of generating electricity from a renewable resource, , to generate a stream of revenue, to reduce greenhouse gas emissions consequently improving air quality, and to distribute the generation of energy thus increasing the reliability of our grid, and create an opportunity for local businesses.

Responsibility of the Proponent(s)

1. The Proponent(s) shall cover all expenses for the design, installation, maintenance, and replacement of solar panels for the farming of solar electricity at one or more of the five (5) sites listed above. The Proponent(s) shall provide, at its own expense, a professional land survey of the land to be leased, an appraisal of the land proposed on ~~landfill~~ any of the five sites and legal description of the proposed land to be leased by the City within one hundred and twenty (120) calendar days from the date of the Notice of Award letter. The parcel(s) of land to be surveyed shall be approved by the City prior to the survey. The Proponent(s) will be responsible for all interconnections and documentation with utility through final start-up and approval. Proponent(s) shall both illustrate and guarantee by invoice statements from Georgia Power Company that solar energy shall be sold as electricity.

2. The City reserves the right to require removal of any portion of the solar equipment as may be necessitated to maintain the landfill or airport property.

3. The Proponent(s) is responsible for reviewing each step with the City.

    a. For those projects on one or both of the Airport parcels, the Proponent(s) must present its design to the DOA Planning and Development (P&D) for review, comment and final approval prior to submitting to the Federal Aviation Administration (FAA) and Georgia Department of Transportation (GDOT) for approval. The Proponent(s) must demonstrate to the FAA that final PV placement will not degrade the signal quality of the Runway 10 glide slope antenna or the Runway 28 localizer outside of CATII/III tolerances. Further, the placement of these arrays will not impact activities conducted in the Air Traffic Control Tower (ATCT) nor pilots utilizing the Airport. Lastly, the Proponent(s) must obtain GDOT approval to ensure no concerns are present for glare impacts on I-285 or Riverdale Road.

4. The Proponent(s) shall pursue any and all financial incentives that may be available. The Proponent(s) shall complete documentation, provide information, testing, results as required by incentive agencies.

5. The Proponent(s) is responsible for obtaining all necessary permits, inspections and documentation for installation, operation, and maintenance. The appropriate City staff will provide assistance where needed in any official communications with the regulatory agencies for permits on the Key Road Landfill, Cascade Road Landfill, Gun Club Landfill, and the two Airport parcels.

6. The Proponent(s) is responsible for delivering, assembling, installing, operating and maintaining (turnkey) the equipment at each site. An Operations and Maintenance plan will be submitted to each City Department.

7. The Proponent(s) will conduct acceptance testing on each system

8. The Proponent(s) is responsible for the maintenance and repair of the PV system(s) as well as maintaining the integrity of the landfill cap and Airport land under and around the solar panels.

9. It is incumbent on the Proponent(s) to make sure its PV offering does not compromise the integrity of the land on which the solar arrays are built:

    a. Landfill caps with questionable structures for the PV modules being offered by the Proponent(s) shall be noted in the Response and loadings shall be validated by a structural engineer prior to installation. The cost to redo the structural analysis shall be at the expense of the Proponent(s).

    b. The slope of the airport parcel must protect the integrity of the slope on which the PV panels are built and the airfield above it.

10. For those bids that include a landfill cap, the age of landfill cap under proposed PV system(s) shall be noted for the City's consideration prior to installation of a PV system.

11. The Proponent(s) working inside of the SIDA is responsible for obtaining SIDA badges for all employees or prepare an employee escort plan to be approved by the City of Atlanta, Department of Aviation's Security Division. Escorting is only allowed for less than 3 days.

12. The Proponent(s) is responsible for obtaining approvals from the Federal Transportation Security Administration as well as the Department of Aviation Security for those proposals that include a permanent and/or temporary relocation of the SIDA fence.

13. The Proponent(s) utilizing one or both of the Airport parcels is required to submit the Security and Safety Plans. The Security Plan must be submitted to DOA Security Division a minimum of sixty (60) days in advance of proposed change's effective date.

14. The Proponent(s) utilizing one or both of the Airport parcels is responsible for obtaining easements and encroachments for the City of College Park sanitary sewer lines and a Georgia Power duct bank.

15. The Proponent(s) utilizing one or both of the Airport parcels is responsible for meeting the minimum P&D DOA Engineering Guidelines (http://apps.atlanta-airport.com/engineeringguidelines/index.asp)

16. The Proponent(s) utilizing one or both of the Airport parcels must be prepared to perform installation work at night or during limited runway closures.

17. The Proponent(s) utilizing one or both of the Airport parcels is responsible for providing a glare analysis that will be reviewed by the Department of Aviation prior to being sent to GDOT and the FAA for approval. The DOA will provide assistance to the Proponent(s) as they complete the FAA 7460-1 form for submission to the FAA. For the glare analysis, the Sandia National Laboratories' Solar Glare Hazard Analysis Tool (SGHAT) will be utilized.

    a. Glare from the panels shall not create a hazard for drivers on Riverdale Road.

    b. Glare from the panels shall not create a hazard for drivers on I-285

    c. Glare analysis shall not create a hazard for airport operations.

18. The Proponent(s) utilizing one or both of the Airport parcels is responsible for filing and acquiring approval of all FAA Form 7460-1's required for development of the property. FAA approval of the 7460-1 is approximately 90 days. The City will assist with the coordination of submittals of the 7460 to the FAA.

19. The Proponent(s) is responsible for removing all material at the end of the lease unless a follow-up agreement between the Proponent(s) and the City is negotiated.

20. With the exception of the airport locations where the number of acres to be leased has been pre-determined, the Proponent(s) shall state the number of acres that they will utilize at the landfill site(s).

Scope of Services

1. The term of the lease agreement between the Proponent(s) and the City shall be for a minimum of 20 years, paid annually. The City is required to lease City-owned land for at least fair market value. Therefore, the selected winning Proponent(s) will be required to complete an appraisal of the land to be leased within 120 days of notification of award. Proponent is required to submit a cost proposal using the form provided in the RFP, amounts to be based on the Proponent's considerations. The Final Annual Lease Payment amounts will be based on the Cost Proposal or the Appraisal Value, whichever is greater.

2. While solar farming on City property, the Proponent(s) shall comply with a minimum capacity of 800 kW per site.

3. The Proponent(s) shall submit a monthly operational report that includes but is not limited to energy generated and operating efficiency. The format and content shall be approved by the City and delivered in soft copy. The City may audit the report at any time and may ask the Proponent(s) to submit the report in hard copy at its discretion.

Contingencies

1. Access to the two Airport parcels is contingent on the project approval by the Department of Aviation as well as the Transportation Security Agency.

2. Access to the two Airport parcels is contingent on FAA approval of the glare analysis for the Airport property. DOA is preparing the initial glare analysis and submittal to the FAA based on P&D's concept design. Should the proponent not use the concept, then the proponent shall provide a new glare analysis to be submitted to the FAA for approval. The DOA will coordinate the submittal of the 7460.

3. Proponent may be released from the contract:

    a. In the event the proponent does not win a bid from Georgia Power's Advanced Solar Initiative; or

    b. In the event that a bid is selected by Georgia Power but the Proponent finds

        i. that electrical interconnection facilities prevent reasonable economic benefit for all parties; or

        ii. that the detailed soil and environmental engineering reports make the project economically infeasible; or

        iii. that the fair market value of the proposed site(s) prevents reasonable economic benefit for all parties.

ATTACHMENTS

1. Exhibit A-1; Cost proposal;
2. Exhibit A-2; Questions to be answered by Proponents;
3. ~~Exhibit A-3; Minimum Lease Request for Airport Parcel I~~ (DELETED)
4. ~~Exhibit A-4; Minimum Lease Request for Airport Parcel II~~(DELETED)
5. ~~Exhibit A-5; Minimum Lease Request for Cascade Road Landfill~~ (DELETED)
6. ~~Exhibit A-6; Minimum Lease Request for Key Road Landfill~~ (DELETED)
7. ~~Exhibit A-7; Minimum Lease Request for Gun Club Landfill~~ (DELETED)
8. Exhibit A-8; Airport Parcels Map
9. Exhibit A-9; Cascade Road Landfill Map;
10. Exhibit A-10; Key Road Landfill Map; and
11. Exhibit A-11; Gun Club Road Landfill.

Attachment No. 3: Cascade Road Landfill (CRLF_Caps_Specs)

Throughout the waste relocation activities, the site was graded to avoid ponding and to promote positive drainage of run-off to sedimentation and erosion control structures. An odor control system was set up and maintained along the perimeter of the landfill to minimize the migration of odors to adjoining properties.

Daily cover materials for the cuts and fills was comprised of clean soil placed in six-inch thick layers. The cover materials was a virgin soil imported from the borrow area adjacent to the landfill. Daily cover was started at such time in the workday to be completed before dusk.

Bridging Layer Installation

The bridging layer was placed as the finished top of waste grades were met. The top of waste grades were maintained continuously by a full-time surveyor registered in the State of Georgia. The bridging layer was installed in one six-inch thick compacted lift. All of the soil material used for the bridging layer was imported from the borrow area located adjacent to the landfill.

Placement of the bridging layer was accomplished by spreading the soil material in an eight-inch thick loose thickness. The layer was compacted with heavy equipment to provide a stable foundation for the infiltration layer. Compaction for the bridging layer in the areas of the cap covered with CCS cap was performed on a visual basis using loaded equipment as a proof roll to identify any unstable areas. Any unstable areas were undercut and replaced with suitable material to provide an unyielding surface for the CCS cap.

Compacted Clay Soil (CCS) Cap Installation

The CCS cap was installed over the majority of the sloped areas of the landfill using the infiltration layer materials taken from the borrow area. The integrity of the infiltration layer was controlled by minimizing the work area, reducing the time to install subsequent lifts, and systematically placing the infiltration layer within the predetermined areas of no greater than approximately 40,000 ft^2 to optimize in-place sampling and production. The CCS cap was

constructed in three six-inch compacted lifts to achieve the minimum required 18-inch thickness. The infiltration layer was placed by spreading the infiltration layer soil material with a dozer to an 8-inch thick loose lift. The layer of soil was then compacted and tested. Subsequent lifts were place immediately after testing to avoid desiccation cracking between lifts. Once the required thickness of 18 inches had been met, the 6" layer of topsoil was placed and seeded to protect the infiltration layer and establish the vegetative cover.

Geosynthetic Liner (GCL) Installation

GCL was installed over a 11.67-acre portion of the landfill area as shown on the As-Built drawing. WESTON and the independent quality assurance contractor provided oversight to insure that the installation of the Geosynthetic Liner Installation (GCL) was in accordance with the manufacturer's recommendation and guidelines. Two types of GCL were used in the cap; Bentomat and Claymax 200R. Bentomat was installed in areas with grades between 10% to 25%, and Claymax 200R was installed in the areas with grades less than 10%. After the GCL was deployed it was covered the same day with an 18-inch thick layer of cover soil materials. This soil material was imported from the borrow area. The top of this cover soil was seeded to establish the protective vegetative cover.

The thickness of all soil layers comprising the final cover system were checked during the construction activities. The thickness of the vegetative cover, infiltration layer and GCL cover were confirmed during the final soil cap thickness verification check performed by WESTON and an independent quality assurance contractor. This thickness verification is presented in detail in Section 4 of this report.

Landfill Gas and Groundwater Monitoring

WESTON performed the installation of the groundwater monitoring system and methane monitoring system. The groundwater monitoring plan and the methane monitoring plan were

Attachment No. 4: Gun Club Landfill (GCL_Guideline)

CETCO

COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY

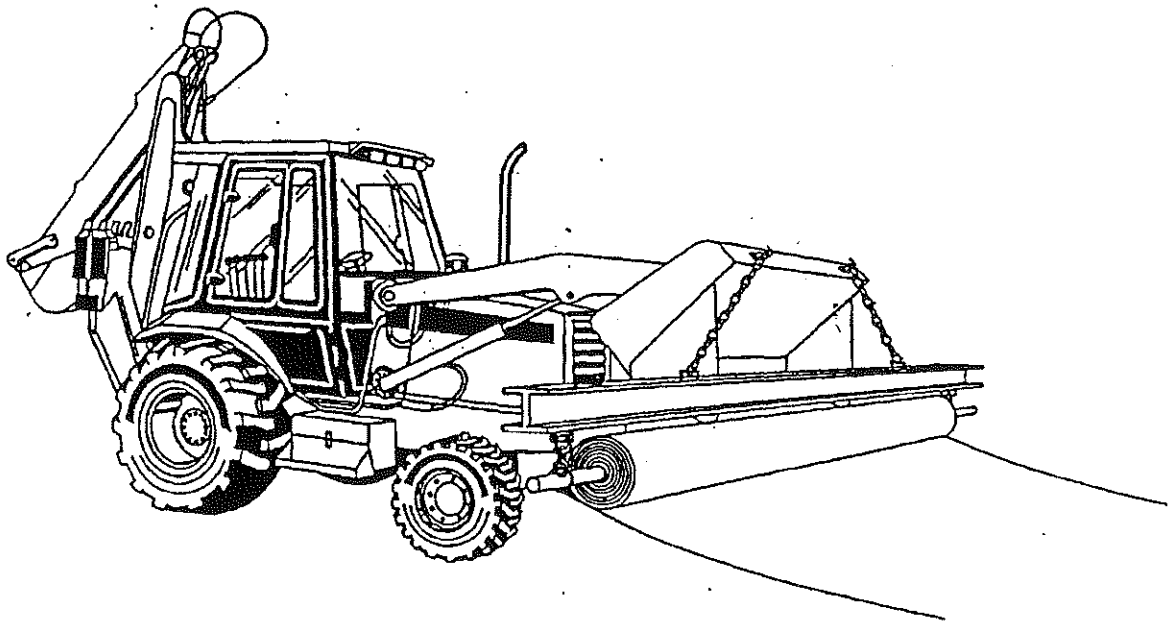
TR-405
October 1995

TECHNICAL DATA SHEET

BENTOMAT®

CLAYMAX®

GEOSYNTHETIC CLAY LINERS INSTALLATION GUIDELINES



This document is intended for use as a GENERAL GUIDELINE for the installation of CETCO's GCLs. Exceptions to this guideline may be required to address site-specific and/or product-specific conditions.

1350 W. Shure Drive • Arlington Heights, Illinois 60004-1440 • (847) 392-5800 • FAX (847) 506-6150
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1 INTRODUCTION

1.1 This document provides procedures for the installation of CETCO's GCLs in a manner that maximizes safety, efficiency, and the physical integrity of the GCL.

1.2 These guidelines are based upon several years of experience at a variety of sites and should be generally applicable to any type of lining project using CETCO's GCLs. The user should contact CETCO if it is believed that conditions at a particular site warrant modifications to these guidelines.

1.3 The performance of the GCL is wholly dependent on the quality of its installation. It is the installer's responsibility to adhere to these guidelines, and to the project specification and drawings, as closely as possible. It is the engineer's and owner's responsibility to provide construction quality assurance (CQA) for the installation in order to ensure that the installation has been executed properly. This document covers only installation procedures. Recommended GCL CQA procedures can be found in CETCO's TR-410.

2 EQUIPMENT REQUIREMENTS

2.1 CETCO GCLs are in rolls weighing from 1,500-2,500 lbs (680-1,140 kg). It is necessary to support this weight using an appropriate core pipe as indicated in Table 1. For any installation, the core pipe must not deflect more than three inches (75 mm) as measured from end to midpoint when a full GCL roll is lifted.

Table 1. Core pipe requirements.

Product	Nominal GCL Roll Size, length x diameter, ft (m)	Typical GCL Roll Wt., lbs (kg)	Interior Core Size, in (mm)	Core Pipe, length x diameter, ft x in (m x mm)	Minimum Core Pipe Strength
Bentomat ST	12 x 100 (3.7 x 30)	1,500 (680)	4 (100)	15 x 3 (4.6 x 75)	Sch. 120
Bentomat ST; DN	15 x 125 (4.6 x 38)	2,500 (1,140)	4 (100)	18 x 3 (5.5 x 75)	XXH
Claymax 200R	13.8 x 150 (4.2 x 45)	2,500 (1,140)	4 (100)	16 x 3 (4.9 x 75)	XXH
Claymax 500 SP	13.8 x 150 (4.2 x 45)	2,500 (1,140)	4 (100)	16 x 3 (4.9 x 75)	XXH

2.2 Lifting chains or straps each rated for at least twice the load of the GCL should be used in combination with a spreader bar made from an I-beam as shown in the cover illustration. The spreader bar ensures the lifting chains or straps do not chafe against the ends of the GCL roll, which must be able to rotate freely during installation.

2.3 A front-end loader, backhoe, dozer, or other equipment can be furnished with the spreader bar and core bar. Alternatively, a forklift with a "stinger" attachment may be used for on-site handling and, in certain cases, installation. A forklift should **not** be used to lift or handle the GCL rolls. Stinger attachments specially fabricated to fit various forklift makes and models are available through CETCO.

2.4 When installing over certain geosynthetic materials, a 4-wheel all-terrain vehicle (ATV) can be used to deploy the GCL from behind. An ATV can be driven directly on the GCL provided that no sudden stops, starts, or turns are made.

2.5 Additional equipment needed for installation of CETCO's GCL includes:

- Utility knives and spare blades (for cutting GCL).
- Granular bentonite or bentonite mastic (for overlapped seams of GCLs with needlepunched non-woven geotextiles and for sealing around structures and details). Both are available from CETCO.
- Waterproof tarpaulins (for temporary cover on installed material as well as for stockpiled rolls.
- Option chalk line marker to simplify bentonite placement at seams (when installing a GCL with needlepunched non-woven geotextile components).
- Optional flat-bladed vise-grip tools (for positioning GCL panel by hand).

3 SUBGRADE PREPARATION

3.1 If the GCL is placed over an earthen subgrade, the surface must be compacted to at least 90 percent modified Proctor density or to the extent required by the project specifications. Engineer's approval of the subgrade must be obtained prior to installation. The finished surface must be firm and unyielding, without abrupt elevation changes, voids, cracks, ice, or standing water.

3.2 The subgrade surface must be free of vegetation, sharp-edged rocks, stones, sticks, construction debris, and other foreign material that could contact the GCL. The subgrade should be rolled with a smooth-drum compactor to remove any wheel ruts, footprints, or other abrupt grade changes. Furthermore, all protrusions extending more than 0.5 inch (12 mm) from the subgrade surface shall either be removed, crushed, or pushed into the surface with a smooth-drum compactor. The GCL may be installed on a frozen subgrade, but the subgrade soil in the unfrozen state should meet the above requirements.

4 UNLOADING

4.1 In most cases, CETCO GCLs are delivered in flatbed trucks. To unload the rolls from the flatbed, insert the core pipe through the roll. This may require removal of the core plug, which should be replaced after the roll is unloaded. Secure the lifting straps or chains to each end of the core pipe and to the spreader bar mounted on the lifting equipment. Hoist the roll straight up; make sure its weight is evenly distributed so that it does not tilt or sway when lifted.

4.2 CETCO GCLs are also occasionally delivered in closed shipping containers. To remove the roll from the container, it is best to utilize a forklift equipped with a "stinger" attachment. Guide the stinger as far as possible through the core and lift the roll up and out of the container.

5 INSTALLATION

5.1 GCL rolls should be taken to the working area of the site in their original packaging. Immediately prior to their deployment, the packaging should be carefully removed without damaging the GCL. The orientation of the GCL (i.e., which side faces up) may be important if the GCL has two different geotextiles. Unless otherwise specified, however, the GCL shall be installed such that the product name printed on one side of the GCL face up.

5.2 Equipment which could damage the GCL shall not be allowed to travel directly on it. Acceptable installation, therefore, may be accomplished such that the GCL is unrolled in front of the backward-moving equipment (Figure 1). If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

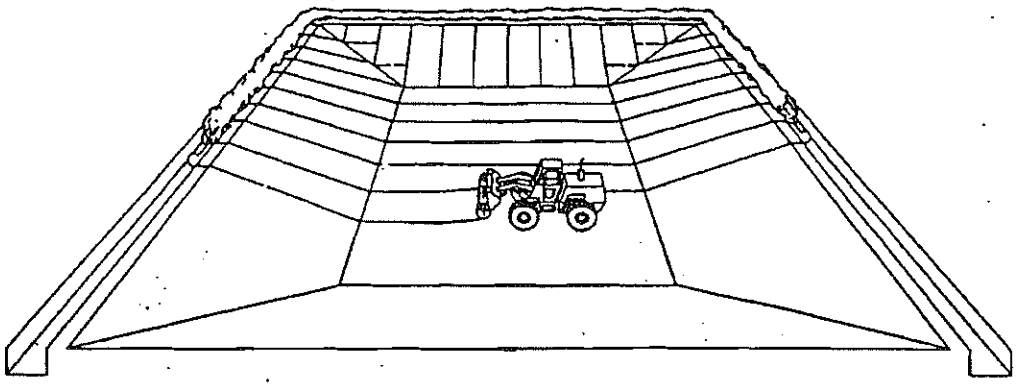

Figure 1. Typical Bentomat / Claymax installation strategy.

5.3 Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.

5.4 The GCL should be placed so that seams are parallel to the direction of the slope. End-of-roll seams should also be located at least three feet (1 m) from the toe and crest of slopes steeper than 4H:1V.

5.5 All GCL panels should lie flat on the underlying surface, with no wrinkles or folds, especially at the exposed edges of the panels.

5.6 Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The project engineer, CQA inspector, and GCL supplier should be contacted for specific guidance if premature hydration occurs.

6 ANCHORAGE

6.1 If required by the project drawings, one end of the GCL roll should be placed in an anchor trench at the top of the slope. The front edge of the trench shall be rounded so as to eliminate any sharp corners that could cause excessive stress on the GCL. Loose soil should be removed or compacted into the floor of the trench.

6.2 Sufficient anchorage may alternately be obtained by extending the end of the GCL roll back from the crest of the slope. The length of this "runout" anchor is project-specific.

6.3 If a trench is used for anchoring the end of the GCL, soil backfill should be placed in the trench to provide resistance against pullout. The size and shape of the trench, as well as the appropriate backfill procedures, should be in accordance with the project drawings and specifications. Typical dimensions are shown in Figure 2.

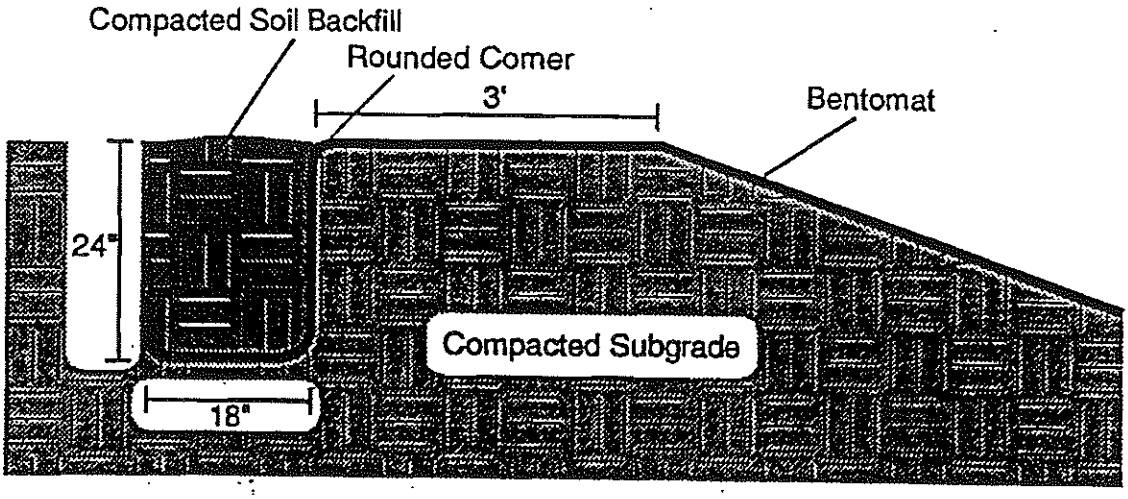

Figure 2. Typical anchor trench location and dimensions.

6.3 The GCL should be placed in the anchor trench such that it covers the entire trench floor but does not extend up the rear trench wall.

7 SEAMING

7.1 GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite is required if the GCL has one or more non-woven needlepunched geotextiles.

7.2 Unless otherwise specified, the minimum dimension of the longitudinal overlap should be 6 inches (150 mm). End-of-roll overlapped seams should be similarly constructed, but the minimum overlap should measure 24 inches (600 mm).

7.3 Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone.

7.4 Bentonite-enhanced seams are constructed first by overlapping the adjacent panels as instructed previously, exposing the underlying edge, and then applying a continuous bead or fillet of granular sodium bentonite (supplied with the GCL) along a zone defined by the edge of the underlying panel and the 6-inch (150 mm) line (Figure 3). The minimum application rate at which the bentonite is applied is one quarter pound per lineal foot (0.4 kg/m).

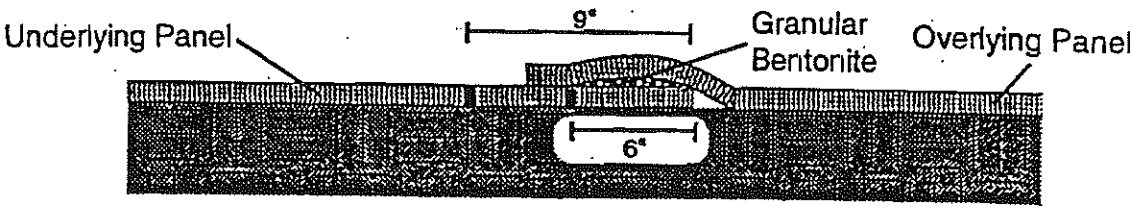

Figure 3. Bentonite-enhanced overlapped seam.

8 SEALING AROUND PENETRATIONS AND STRUCTURES

8.1 Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are recommended to avoid irregular tearing of the geotextile components of the GCL during the cutting process.

8.2 The GCL shall be sealed around penetrations and structures embedded in the subgrade in accordance with Figures 4 through 6. Granular bentonite or bentonite mastic shall be used liberally (approximately 2 lbs/linear ft or 3 kg/m) to seal the GCL to these structures.

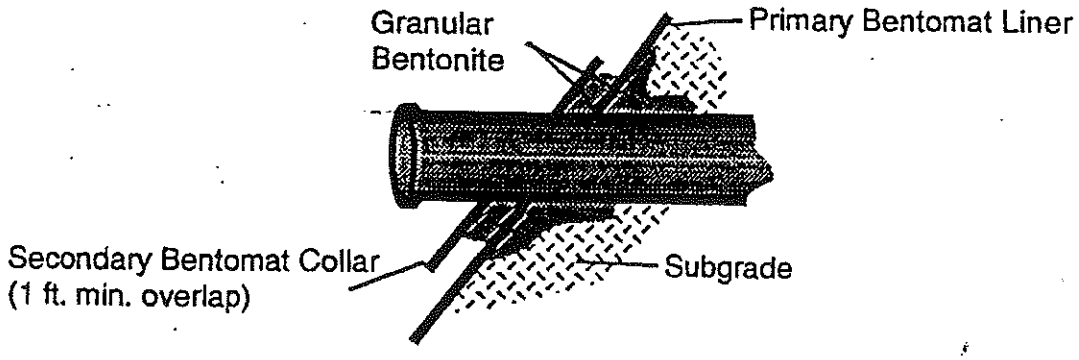

Figure 4a. Cross-section of a horizontal pipe penetration.

8.3 When the GCL is placed over an earthen subgrade, a "notch" should be excavated into the subgrade around the penetration (Figure 4a). The notch should then be backfilled with granular bentonite or bentonite mastic.

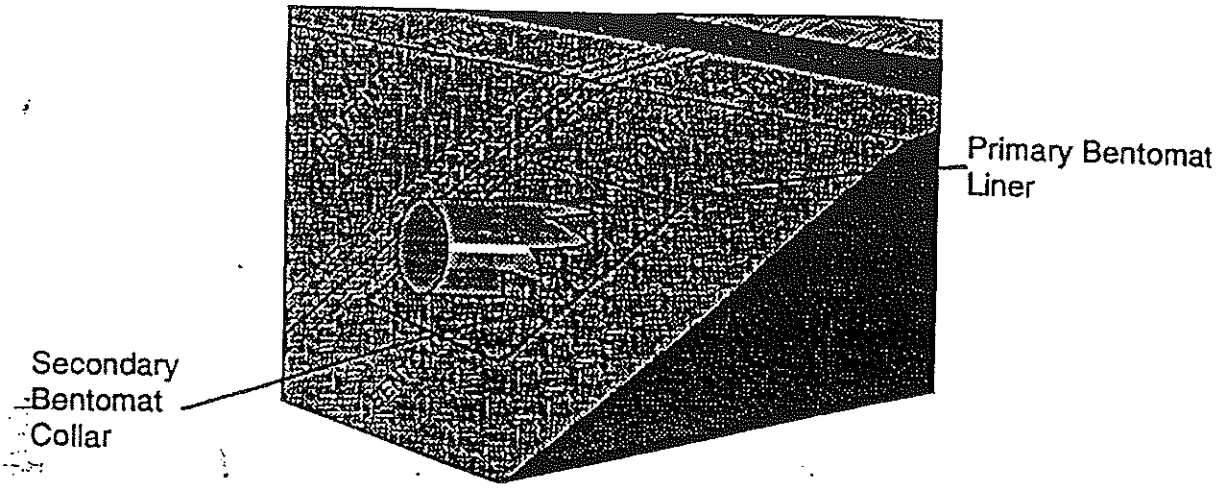

Figure 4b. Isometric view of completed horizontal pipe penetration.

8.4 A secondary collar of GCL should be placed around the penetration as shown in Figure 4b. It is helpful to first trace an outline of the penetration on the GCL and then to cut a "star" pattern in the collar to enhance the collar's fit around the penetration.

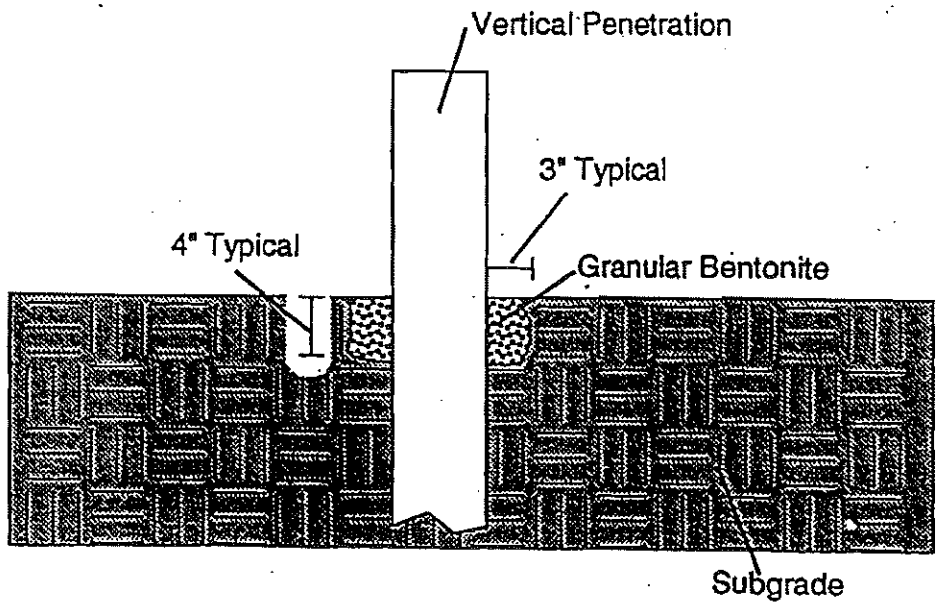

Figure 5a. Cross-section of a vertical penetration.

8.5 Vertical penetrations are prepared by notching into the subgrade as shown in Figure 5a. The penetration is completed with two separate pieces of GCL as shown in Figure 5b. A secondary collar is optional in this case.

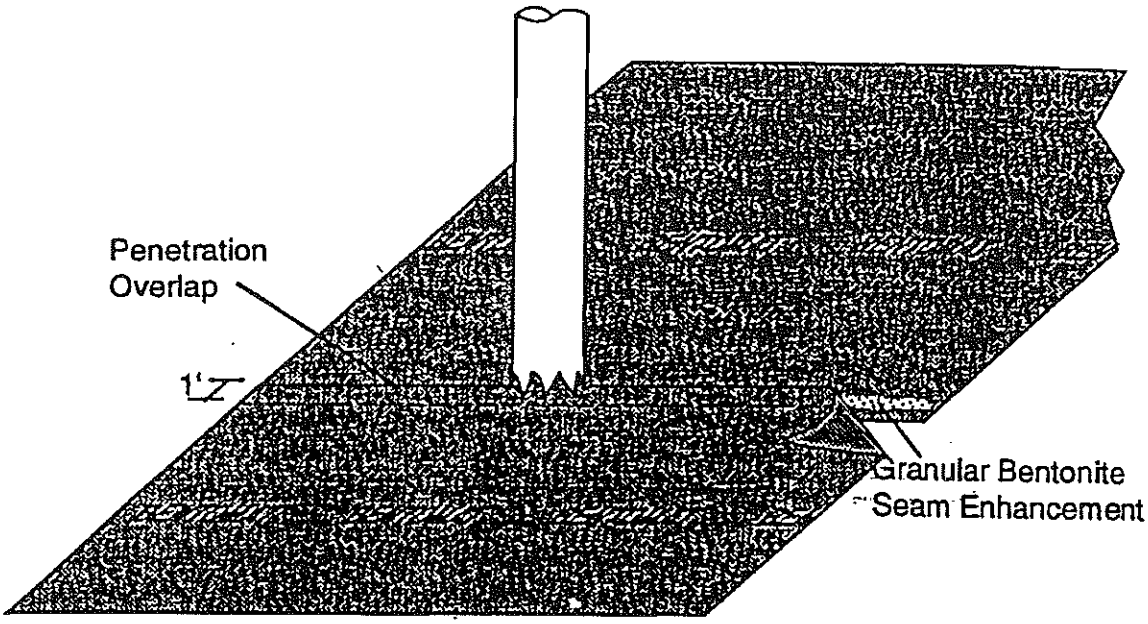

Figure 5b. Isometric view of completed vertical penetration.

8.6 When the GCL is terminated at a structure or wall that is embedded into the subgrade, the subgrade should be notched as described in Section 8.3 and 8.5. The notch is filled with dry granular bentonite, and the GCL should be placed over the notch and up against the structure. The connection to the structure can be accomplished by placement of soil or stone backfill in this area.

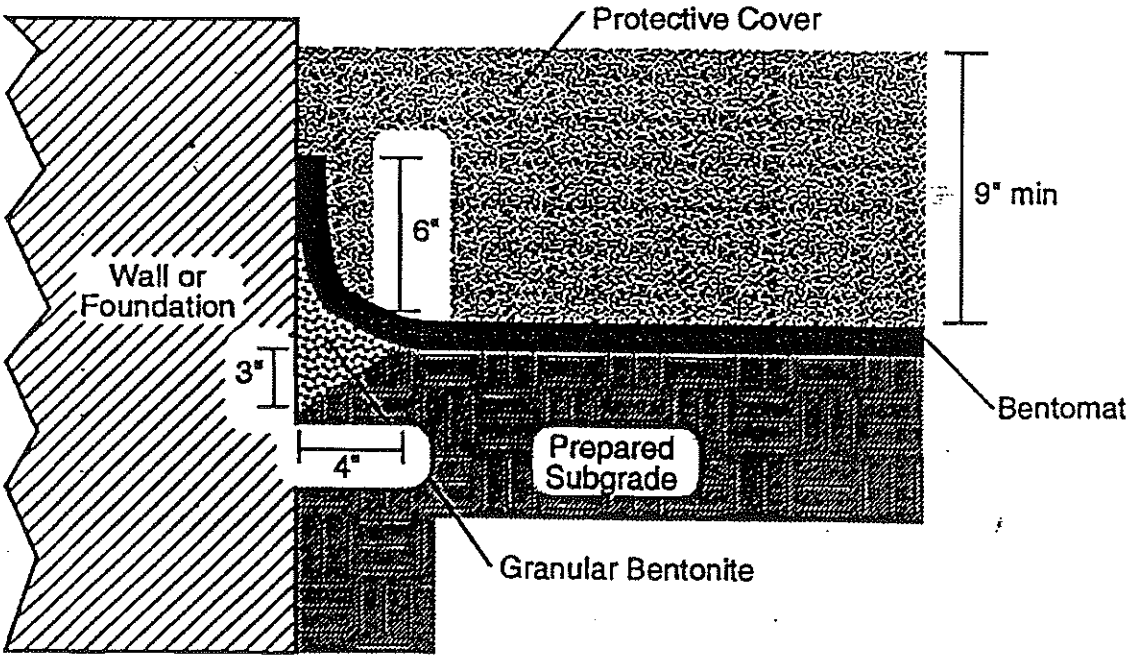

Figure 6. Cross-section of GCL against an embedded structure or wall.

9 DAMAGE REPAIR

9.1 If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by placing a patch over the damaged area (Figure 7). The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 12 inches (300 mm) is achieved around all parts of the damaged area. Granular bentonite or bentonite mastic should be applied around the damaged area prior to placement of the patch. It may be necessary to use an adhesive such as wood glue to fix the patch in place so that it is not moved during cover placement. Smaller patches also may be tucked *under* the damaged area to prevent patch movement.

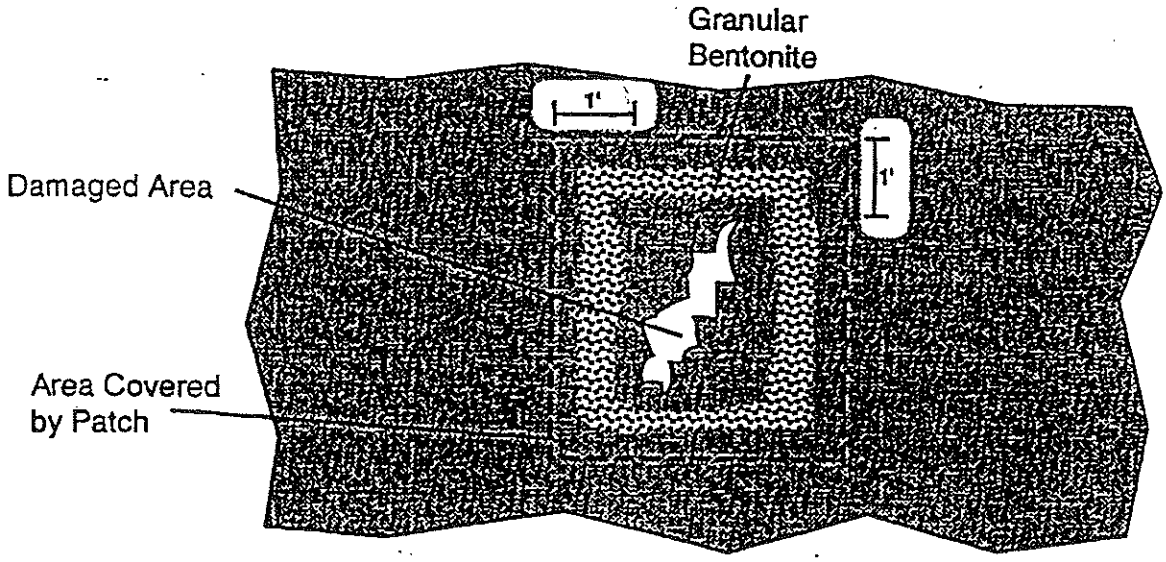

Figure 7. Damage repair by patching.

10 COVER PLACEMENT

10.1 Cover soils shall be free of angular stones or other foreign matter which could damage the GCL. Cover soils should be approved by the Engineer with respect to particle size, uniformity, and chemical compatibility.

10.2 Recommended cover soils typically have a particle size distribution ranging between fines and 1 inch (25 mm). Soils with minimal fines or a high concentration of aggregate larger than 1 inch may require a field-scale test using the proposed subgrade surface, cover soil, and placement and compaction equipment. Following construction of the test pad, the GCL should be exhumed and inspected for any damage to the synthetic components of the GCL and for areas of visible bentonite displacement.

10.3 Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum thickness of one foot (300 mm) of cover should be maintained between the equipment tracks/tires and the GCL at

all times during the covering process. This thickness recommendation does not apply to frequently trafficked areas or roadways, for which a minimum thickness of 2 feet (600 mm) is required.

10.4 The *final* thickness of soil cover on the CETCO GCL varies with the application, but this cover layer should be **at least** one foot (300 mm) thick to prevent damage by equipment, erosion, etc.

10.5 Soil cover should be placed in a manner that prevents the soil from entering the GCL overlap zones.

10.6 Although direct vehicular contact with the GCL is to be avoided, lightweight, low ground pressure vehicles (such as 4-wheel all-terrain vehicles) may be used to facilitate the installation of geosynthetic products placed over the GCL. Contact CETCO for more specific recommendations on the appropriate procedures for this situation.

10.7 When a textured geomembrane is installed over the GCL, a temporary geosynthetic covering known as a slip sheet or rub sheet should be used to minimize friction during placement and to allow the textured geomembrane to be more easily moved into its final position.

11 HYDRATION

11.1 In projects involving the containment of non-aqueous liquids (secondary containment around above-ground storage tanks), the GCL must be hydrated with clean water prior to use. The GCL does not function as a barrier until hydration takes place. Hydration is usually accomplished by natural rainfall if the GCL is covered by permeable material.

11.2 If manual hydration is necessary, water can be introduced by flooding the lined area or by the use of a sprinkler system. Contact CETCO for specific procedures in these cases.

Attachment No. 5: GCL_QA_Manual

Geosynthetic Liner Materials Construction Quality Assurance Manual

Rich Berube

CETCO

COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY

TR-410
11-20-97

TECHNICAL DATA SHEET

CETCO GCL

CONSTRUCTION QUALITY ASSURANCE (CQA) MANUAL

Version 2.0, November 1997

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SECTION 1
INTRODUCTION

1.1 Definitions

Construction Quality Assurance. For the purposes of this manual, construction quality assurance (CQA) is defined as a planned system of activities that provides assurance that *installation* of the geosynthetic clay liner (GCL) proceeds in accordance with the project design drawings and specifications. In general, these activities include continuous inspection of the installation, testing of materials and procedures, and overall documentation.

Construction Quality Control. Again, for the purposes of this manual, construction quality control (CQC) is defined as a planned system of activities that provides assurance that the properties of the GCL *materials* meet the requirements of the project specifications. These activities primarily include materials testing and documentation.

There is a great deal of overlap in the nature of CQA and CQC, and from a practical standpoint, CQA and CQC activities are often performed by the same party. For this reason, we will use the term CQA to describe *all* of the quality-oriented tasks relating to the GCL and its installation.

1.2 Scope and Purpose of the CQA Manual

This manual is written to address third-party CQA activities and is *not* intended as a guide for GCL installation. Installation guidelines are available separately from CETCO (see Technical References TR-405). This manual is also not intended to describe the various *manufacturing* quality assurance and quality control (MQA/MQC) activities performed by CETCO at the GCL manufacturing facilities (see Technical Reference No. TR-409).

The purpose of the CQA Manual is provide the project CQA personnel with a general format for assuring that the GCL delivered to the job meets the requirements of the specifications and that this material is installed in accordance with the design drawings and specifications. This manual should be modified as necessary by the design or CQA engineer in order to account for site-specific or project-specific concerns and conditions. Any such changes, however, should be discussed with CETCO before they are introduced into the final version of the project CQA plan.

For the convenience of the CQA personnel, an overall CQA Checklist is provided in Appendix A. This checklist or a similar version thereof is designed to be used on a daily basis to document that all CQA activities are consistently executed throughout the project. The checklists should be maintained at the job site and should be included chronologically in the final CQA documentation package (Section 7).

SECTION 2
PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

It is vital that all parties involved in the installation of the GCL are in close communication with each other throughout the project, and that they fully understand the requirements of the project CQA plan. For the purposes of this manual, the qualifications and responsibilities of the various parties are delineated as follows:

Installing Contractor. Responsible for installing the GCL. The contractor should appoint an on-site Construction Supervisor to coordinate the installation effort and to interact with the other parties on the job site.

Ideally, the installing contractor should have prior experience in GCL installation and should staff the project with certified technicians. In November 1992, the National Institute for Certification in Engineering Technologies (NICET) began a program for the certification of installers of geosynthetic materials, including GCLs. Certification requires employer recommendations, field experience, and successful completion of written examinations. A prospective technician may select from several geosynthetics subfields and may pursue different levels of certification. It is encouraged that, at a minimum, the on-site supervisor be a NICET-certified technician.

On-Site Engineer. Usually the design engineer or designee, this person is responsible for general oversight of the installation. Provides assurance that construction is performed as designed, although not formally responsible for CQA. Primary contact when the installing contractor is in need of clarification of design issues. Primary contact for dispute/problem resolution. This person should be a registered professional engineer.

CQA Engineer. Charged with CQA for Bentomat installation as well as for any other liner system components. Oversees all CQA inspection, testing, and documentation. This person should be a registered professional engineer or a NICET-certified geosynthetics installation technician. This person must also be independent of the other parties on site.

Manufacturer's Representative. CETCO may provide on-site start-up assistance, especially those in which the installer has little or no prior experience or where unusual site conditions exist. The on-site engineer or installer is responsible for notifying CETCO of the intended installation schedule such that CETCO may provide timely guidance during the critical start-up process. CETCO's substantial GCL installation experience may provide valuable insights to the uninitiated engineer and/or installer.

CETCO also acts as the liaison between the manufacturing plant and the installer and coordinates the release of GCL from the plant in accordance with the installer's schedule. CETCO's *on-site* involvement is typically lessened when it is determined that the installer is sufficiently capable of installing GCL without CETCO's continuous assistance. CETCO remains available throughout the project should questions or problems arise.

CQA Laboratory. The GCL conformance tests in this manual are designed to be performed at the job site to facilitate real-time response as test results are generated. In some projects where additional testing is required, however, it may be necessary to utilize the services of an off-site laboratory. The on-site engineer should verify that the selected laboratory has ample experience in the testing of GCLs and is aware of the general content of the project CQA plan as well as its specific testing requirements. The CQA engineer should establish a key contact at the laboratory to coordinate sample delivery procedures, confirm testing parameters and methods, and arrange the timely reporting of test results.

It is recommended that a preconstruction meeting be held between the above parties in order to establish working relationships with one another and to review the design drawings and specifications prior to deployment of the GCL. Thereafter, regular meetings on a daily or weekly basis are recommended as the project continues.

SECTION 3
ON-SITE HANDLING

This section describes the procedures and equipment to be used in handling the GCL when it arrives at the job site. Proper execution of these procedures will ensure that the GCL is not damaged prior to installation. It should be noted that ASTM D 5888 also provides guidelines for GCL handling. The recommendations included herein are consistent with all ASTM guidelines.

CETCO's GCLs are produced in slightly different sizes depending upon the product selected. Weights and dimensions of these products and their corresponding core pipe sizes required for safe handling are provided in Table 1 below.

Product	Panel Size (m)	Roll Diam. (mm)	Roll Weight (kg)	Core Diam. (mm)	Core Pipe Diameter (mm)	Core Pipe Length (m)	Minimum Core Pipe Strength
Bentomat	4.57 x 45.7	610	1,225	100	75-90	5.5	XXH
Claymax	4.21 x 45.7	510	1,130	100	75-90	5.0	XXH

Table 1. GCL panel sizes and corresponding core pipe requirements.

It should be recognized that the weight of the GCL rolls will dictate what type of core pipe will be sufficiently strong for unloading and handling activities. Experience has shown that the type of steel from which the pipe was produced will influence its ability to sustain the weight of the roll. The strongest steel available should be used to prevent pipe bending. A core pipe that deflects more than 75 mm as measured from end to midpoint when the roll is lifted can cause damage to the GCL and is *not acceptable*. The pipes used to unload or deploy the GCL *must not bend* at any time.

3.1 Unloading Procedures

The GCL may be delivered to the job site in one of two ways: by flatbed truck or by closed trailer/container. Regardless of the delivery method, all unloading activities should take place away from main roadways and high-traffic areas at the site. The designated unloading area should be flat, dry, and stable, and should provide adequate peripheral access for the unloading equipment. Different techniques for unloading the GCL are used accordingly. Using the procedures and equipment described below will minimize unloading time.

3.1.1 Flatbed Truck Delivery

A front-end loader or backhoe is typically used to remove the rolls from the flatbed truck. Starting from the top rolls on the truck, the core pipe is inserted through the roll core. The core has an inside diameter of 100 mm but may be slightly bowed upon arrival to the job site. In this case, it may be necessary to assist the core pipe insertion process by using the back of the loader bucket to carefully push the pipe through the core.

After the core pipe has been inserted, straps or chains are looped around each end of the pipe protruding from the roll. The other ends of the chains should be connected to a spreader bar (typically an I-beam) of equal length to the core pipe. The spreader bar itself is suspended from the loader bucket. The purpose of the spreader bar is to prevent the chains from chafing the ends of the roll as it is lifted. It is recommended that the chains or straps be secured by the placing a pin through each end of the pipe. The GCL roll should then be lifted and slowly carried from the flatbed to the temporary storage area.

3.1.2 Trailer or Container Delivery

The GCL may also be delivered in closed trailers or shipping containers. In these cases, different unloading equipment and techniques must be employed. Because of limited access to the GCL rolls, it is usually necessary to utilize an extendable-boom forklift with a "stinger" attachment. The forklift dealer or manufacturer can provide details on selecting the proper stinger for the type of forklift used at the job site.

The rolls are placed inside the trailer or container in the same way that they are positioned on a flatbed truck. The rolls are removed by inserting the stinger through the roll cores and lifting/pulling the rolls from the trailer/container.

3.2 Materials Handling

The equipment used to unload the GCL from the delivery vehicle may also be used to handle the material on site and to convey it to work areas. All unloading and handling activities must be undertaken with great care to avoid damage to the GCL. The GCL should never be handled in ways that could affect its performance. Some activities to avoid:

- Dropping the rolls from the edge of the delivery truck or container.
- Pushing or pulling the rolls on the ground surface.
- Lifting the roll without a core pipe.
- Bending the rolls by using a core pipe that cannot bear the weight of the roll.
- Forcing a bent core pipe through the core.
- Carrying the GCL over excessively rutted, bumpy terrain, causing the roll to bend and bounce in transit.

Adherence to these common-sense precautions will prevent handling-related damage to the Bentomat.

The CQA engineer or designee should supervise the unloading and storage operations. It is the duty of the CQA engineer to maintain records of the shipments and to verify that the roll numbers on the labels match the roll numbers on the bills of lading. Any apparent discrepancies should be noted and reported to CETCO.

At this time, all of the rolls should also be visually inspected for damage. Damaged rolls should be clearly marked and set aside where they will not be immediately used. Major damage suspected to have occurred during shipment should *immediately* be reported to the carrier and to CETCO (see Section 4.8.1).

3.3 On-Site Storage

The GCL may be stored at a project site indefinitely, provided that proper storage procedures are followed. First, a dedicated storage area should be identified. This area should be level, dry, well-drained, and located away from high-traffic areas of the job site.

For reasons of safety and material integrity, GCL rolls must never be stored on end. Rolls should be stored horizontally, in small stacks not to exceed four to five rolls in height. It is preferred that the bottom rolls be placed on plywood, on an arrangement of pallets, or on some other man-made surface; to promote drainage and to prevent damage by contact with the ground surface. If the rolls are to be placed

directly on the ground, the local ground surface should be carefully prepared and proof-rolled to minimize the potential for damage. It is good practice to cover the stored rolls with a tarpaulin or plastic sheeting for supplemental protection from the elements.

The polyethylene sleeves of the GCL rolls should be examined for any obvious rips or tears. Sleeve damage should be repaired immediately with adhesive tape or additional plastic sheeting. At this time it is also recommended that the labels be examined and taped to the roll if they were displaced in transit.

SECTION 4
INSTALLATION

This section of the CETCO GCL CQA Manual covers the techniques and procedures to be used for ensuring the quality of a GCL installation. Although some installation techniques are described, this section is *not* an installation guide. Refer instead to CETCO GCL Technical Reference TR-405 for specific GCL installation guidelines. ASTM D 6102 also contains sound GCL installation guidelines.

4.1 Start-Up Assistance

CETCO or its representatives can provide on-site start-up assistance, especially where the installer has little or no prior GCL installation experience or in which the application is relatively unique. CETCO will work with the on-site engineer and CQA engineer in order to verify that the proper unloading, installation, and conformance testing procedures are utilized. CETCO's input is based on extensive experience with GCL installation and on intimate knowledge of the physical characteristics of GCLs. It should be recognized, however, that it is the site engineer's responsibility to implement CETCO's recommendations.

4.2 Equipment

In many projects, the equipment used for unloading the GCL can also be used to install it. Most applications require a vehicle to lift and suspend the roll as it is deployed. Front-end loaders, bulldozers, boom cranes, forklifts, and tracked excavators all have been successfully used for this task. Other, more specialized equipment exists for these operations and may also be used. The equipment for unrolling the GCL should be able to lift the roll and suspend it *freely* such that it does not chafe against the vehicle or the ground. The vehicle must also have the ability to accommodate a spreader bar above the roll of GCL.

The spreader bar should be sufficiently strong to bear the full weight of the GCL roll without bending. Readily available I-beams or T-beams made of structural steel are typically used for this purpose, although steel pipes have also been successfully used. The chains or straps should be checked for their strength before the installation is begun and should continually be inspected for wear as the installation continues.

The core pipe should be of the dimensions and strength indicated in Table 1. It has been CETCO's experience that the schedule of the core pipe is not always an accurate indicator of its strength. The type of steel from which the pipe is made, the presence of a longitudinal weld, and the overall length of the pipe all have an influence on its ability to sustain the weight of the GCL. It is essential that the core pipe *does not bend* when the full roll of GCL is suspended from it. Lastly, it is recommended that the core pipe have a means to prevent the chains or straps from slipping off the ends of the pipe. This can be accomplished by using pins or clamps.

It will often be necessary to cut the GCL before the end of the roll or to cut it to fit in certain confined areas. Cutting the GCL requires a *sharp* utility knife. It is very important to maintain the sharpness of the knife blades used for cutting the GCL, in order to prevent tearing its geosynthetic components and damaging the GCL where the cut is made. Frequent blade changes for the utility knife are strongly recommended.

For construction of the bentonite enhanced overlapped seams of the Bentomat products, an acceptable fillet of bentonite can be poured directly from the bags of granular bentonite supplied with each roll of Bentomat, but a watering can (without a sprinkler head) is easier to use and produces a more controlled seam enhancement. A line chalker, such as those used for marking athletic fields, may also be used.

4.3 Field Conditions

At the beginning of each working day, the CQA engineer should confirm that there are no ambient site conditions which could affect the quality of the installation. Specifically, the presence at the job site of excessively high winds, rain, standing water, or snow may be construed as unsuitable weather for GCL installation. There are no temperature restrictions for installing the GCL, however.

Bentomat is not as susceptible as Claymax to damage due to "premature hydration" (i.e., hydration before a confining stress is applied). Although Bentomat will not delaminate when wetted, CETCO nevertheless recommends that it be installed in dry weather as with Claymax. This lessens the potential for damage to the material and ensures that its integrity is not compromised by the swelling of the bentonite. Should the GCL become prematurely hydrated, it urged that CETCO be contacted in order to recommend a project-specific and product-specific recommendation as to whether the GCL must be removed and replaced.

4.4 Site Inspection

Prior to each day's installation activities, the site engineer and/or CQA engineer should inspect the work area to ensure that it has been prepared in accordance with the specification and design drawings. Specifically, the design grades should be verified, the slope length and steepness should be checked, the anchor trench dimensions should be measured, and the subgrade should be inspected and approved. Any deviations from the specifications or design drawings should be noted and rectified before the GCL is installed.

The anchor trench is especially important in applications where slopes are present. The anchor trench must meet or exceed the design dimensions but must also be free of any sharp corners or protrusions which could put excessive stress on the GCL. The CQA engineer must ensure that the anchor trench is as carefully prepared as the rest of the subgrade.

4.5 Panel Placement

The unrolling and placement of the GCL should be performed in such a way that the GCL is not damaged or unduly stretched, folded, or creased. The GCL rolls are typically suspended from the front of the vehicle while it travels backwards along the intended path of placement. During this activity, the roll should be able to rotate freely around the core pipe. Excessive friction due to a bent or large-diameter core pipe, or due to contact between the roll and the deployment equipment, may cause undesirable levels of tension to develop. It is necessary that the GCL be deployed in a fully relaxed (but not wrinkled) state.

A common deployment technique when the GCL is placed on slopes is to suspend the roll at the top of the slope while several laborers unroll it as they walk downslope. This is an acceptable technique, but the CQA engineer should verify that excessive tension does not develop on the material and that the underside of the panel is not damaged by friction with the subgrade. Unless the subgrade is acceptably smooth, the GCL should be unrolled over an already-placed panel and then moved laterally into its correct position. Flat-bladed vise grips are very useful for handling and moving unrolled panels.

It is important to ensure that, at the top of a slope, the GCL is properly placed in the anchor trench. After confirming that the trench has been constructed according to the specifications, the GCL should be placed in the trench such that it extends across the trench floor but not up the rear wall of the trench. Excess material if any, should be cut off, not folded over on top of the existing material. Proper anchorage will be achieved if and only if the GCL is placed within the trench in this manner.

The orientation of the GCL panels is important. When working in sloping areas, the panels should be positioned such that their long dimension is parallel to the direction of the slope. Panels may only be

placed across the slope when the slope is less steep than 4H:1V or when the slope length is very short (less than or equal to 3 m).

4.6 Seaming

Proper field seaming is vital for the liner to function to its maximum abilities. There are three elements of CQA for this important task:

- Verification of the minimum acceptable overlap.
- Verification of the continuity of the accessory bentonite (Bentomat only).
- Verification that there is no dirt in the overlap zone or on the bottom geotextile of the overlying GCL panel.

These elements for field seam CQA are straightforward and require only visual inspection by the CQA engineer. The upper surface of the GCL has two heavy dashed lines on both sides of the panel. The lap lines are 150 mm from the edges of the panel, and the match lines are 250 mm from the edges of the panel. The minimum acceptable overlap is 150 mm. Thus, the installer's objective is to place the overlying panel *between* the two lines of the underlying panel. The CQA engineer needs only to visually verify that the 150 mm lap line of the underlying panel is not visible. A properly executed seam, therefore, is verified when three dashed lines (not four) are visible at the overlap, as shown in Figure 1.

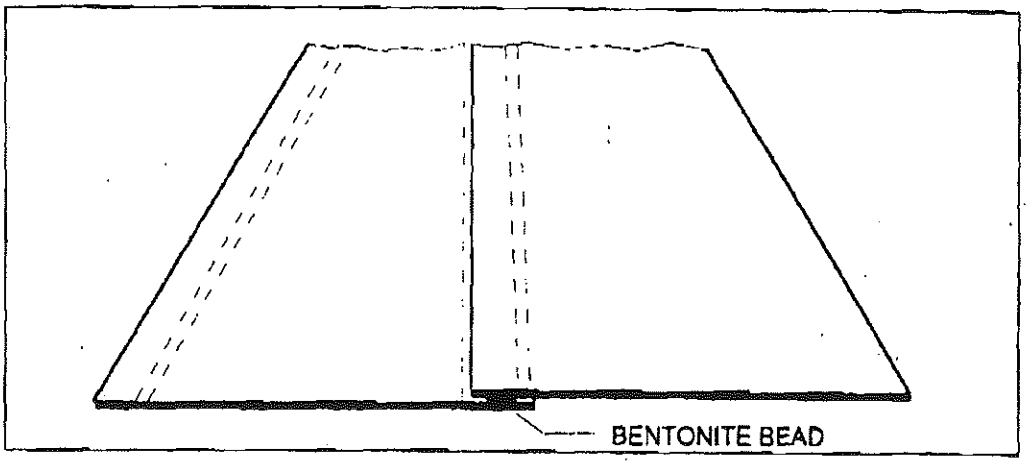


Figure 1. Schematic representation of a properly executed Bentomat field seam.

The hydraulic performance of Bentomat is maximized when the accessory bentonite is placed *continuously* within the overlap zone. Continuity is best achieved when a watering can or other similar device is used. Pouring the bentonite directly from the bag is less effective in this regard. Verification of continuity should be performed visually by the CQA engineer. The CQA engineer should observe the accessory bentonite as it is being placed within the overlap zone and should give verbal approval of the seam before the overlap is flipped back into place.

Verification of the cleanliness of the overlap is also required, because dirt can enter the overlap and create a conduit for excessive lateral leakage. This is one reason CETCO recommends that the overlying panel be placed and then its edge flipped back to reveal the overlap zone. Exposing the overlap in this manner forces extra attention on the seam and reveals the presence of loose dirt that may have inadvertently

entered the overlap zone or may have become adhered to the bottom geotextile of the overlying panel. The CQA engineer should either verify that no dirt is present or ensure that the dirt is swept out of the overlap.

Verification of the *amount* of bentonite placed at the seam may be achieved by ensuring that one full 22.5 kg bag of granular bentonite is used for the lateral and longitudinal seaming of each roll of GCL. CETCO recommends that a minimum of 375 grams of granular bentonite be applied per lineal meter of seam. If the installer places bentonite at the rate of one bag per roll, this target application rate will be achieved.

As stated above, the longitudinal overlap for the GCL should be at least 150 mm. Overlaps at the *ends* of the rolls, however, ("transverse" overlaps) should be at least 0.5 m to account for any incidental loss of bentonite that could occur due to excessive handling of this portion of the roll or to stress relaxation after placement. Overlap distances can always be increased if unusual site conditions such as a soft subgrade exist.

4.7 Detail Work

The term "detail work" refers to the placement of GCL around structures such as vertical walls, gas vents, drainage basins, and pipe penetrations. In all of these cases, it is necessary to utilize granular bentonite or a bentonite mastic to create a seal between the GCL and the structure. CQA of these areas involves a visual inspection of the methods used to make the seal. Specific items requiring inspection include:

- Dimensions of the "notch" excavated around the structure.
- Amount of bentonite applied to the detail
- Condition of the GCL at its cut edge (the cut should be clean, not frayed, with little or no bentonite edge loss from the GCL)
- Integrity of the detail as cover material is placed over and around it.

When cutting the GCL, it is important to ensure that the cut is made where the GCL hangs from the roll or where it rests on the subgrade . The GCL cut should *never* be made on the roll itself or when it rests on any other liner system component.

4.8 Damage and Damage Repair

Even when all reasonable protective measures are taken, the GCL may still become damaged during shipping and handling or during installation. This section provides instructions on assessing and managing the damaged materials.

4.8.1 Damage From Shipping and Handling

Occasionally, a GCL roll will arrive at a job site with its protective plastic sleeve torn due to movement during transit. This roll should be inspected for damage in the area where the sleeve was torn. If the geotextile under the torn sleeve is also torn, The outermost wrap of GCL on the roll should be unwound and discarded when the roll is installed. It is not necessary to consider the entire roll unusable. It is important, however, to mark the roll in order to alert the installer that the initial wrap should be cut away and discarded, because the damaged geotextile may be hidden from view when the GCL is unrolled. It is remotely possible that further layers of GCL on the roll could be similarly damaged. If this happens, additional wraps may be unrolled and discarded prior to placement.

Damage due to poor handling may occur as a result of accidentally dropping a suspended roll onto the ground or using weak core pipes that bend when the GCL is lifted. These activities can cause damage not just to the outer wrap of GCL but to the entire roll. If such damage occurs, the rolls should be clearly marked and moved away from the storage area. The CQA engineer should ensure that procedures are immediately implemented in order to prevent the recurrence of this problem. The CQA engineer should also contact CETCO to help make a determination as to whether the mis-handled GCL is acceptable for use on the project.

4.8.2 Damage From Installation Activities

The more commonly observed incidents of damage occur during installation, as a result of inadvertent contact by heavy equipment. Because this type of damage will potentially have the largest overall effect on the integrity of the liner system, CETCO strongly recommends that equipment operating on or near the GCL *be monitored continuously*.

Equipment operators should be made fully aware of the importance of their actions and should be encouraged to notify the CQA engineer directly if they suspect at any time that the liner may have become damaged by their equipment. Close communication among everyone involved in the installation will help to ensure that this type of damage is reported and repaired.

Repeated passes by loaded dump trucks over GCL which has minimal cover can cause damage. It is therefore preferred to prevent potential for such damage by placing the GCL over these high-traffic areas *after* cover material delivery is largely completed. If this is not possible, then extra cover should be placed over high-traffic areas. At least 600-900 mm of screened, cohesive soil is recommended.

Should damage occur to the already-installed GCL, the following procedures should be followed:

1. Remove equipment from the damaged area and notify the CQA engineer.

2. *Manually* clean away all cover material within a 600 mm radius of the damaged area. Use a broom to sweep away the remaining dirt in order to make the area as clean as possible.

3. If necessary, repair the subgrade to its original conditions. Replace the torn/damaged GCL as closely as possible to its original position.

4. Place a bead of granular bentonite or bentonite paste at the minimum rate of 500 g per lineal meter around the damaged area.

5. Cut a patch of new GCL to fit over the damaged area and extending 600 mm beyond it.

6. Place the patch over the damaged area, and carefully backfill over the patch.

Note that it is necessary only to repair the damaged portion of the GCL. It is usually not necessary to remove and replace the entire panel, unless the damage has occurred on a slope. In this case, slope stability may be compromised and the site engineer should be contacted to help determine whether a repair is acceptable.

SECTION 5
PLACEMENT OF COVER MATERIALS

As mentioned previously, the proper placement of cover on the GCL is crucial to the overall success of the installation. This section of the Bentomat CQA manual includes recommended materials and procedures which will help to ensure that the integrity of the GCL is not compromised when it is covered.

Regardless of the nature of the cover material used, it should be placed as soon as possible after the GCL has been deployed. The efforts of placing the GCL and placing the final cover should be coordinated to the extent that only as much GCL as can be covered should be deployed in one working day. This will prevent premature hydration and will greatly reduce the chances for incidental damage to the GCL during other activities.

5.1 Soil/Stone Cover

When a GCL is the sole liner system component, soil or stone cover *must* be placed over it to provide protection from physical damage, erosional forces, and degradation by UV light. The presence of cover also provides a confining stress which allows the overlapped seam to perform properly and enhances the long-term physical integrity of the material. Lastly, the cover may provide a base for vehicular traffic. Because it serves so many functions, proper placement and CQA of the soil/stone cover is essential.

Frequently used cover materials include sand, gravel, crushed stone, and common earth fill. Regardless of the type of material selected for the cover, it should be free of large stones (greater than 50 mm in diameter), sticks, and any other materials which could cause puncture or tearing. The source of all cover material should be identified in order to ascertain its suitability well in advance of the installation.

In addition to particle size, the *angularity* of a crushed stone or gravel will impact the construction survivability of the GCL. It is preferred that relatively rounded materials be utilized. If these materials are not available, then extra caution must be taken during cover placement. Dumping the cover from a loader bucket positioned high above the GCL is unacceptable. The cover should be gently placed from as low a height as possible. Vehicular traffic should also be restricted if particularly angular or abrasive material is used. If there is some doubt as to the suitability of a potential cover material, a representative sample should be submitted to CETCO for analysis.

With respect to the equipment used to place the protective cover, it is strongly recommended that no heavy equipment come in direct contact with the GCL. Obviously, tracked equipment will damage the liner. In some cases, however it is necessary to drive equipment directly on the GCL. This can be accomplished with low-pressure, *rubber-tired* equipment. Permission to do so will be granted by CETCO through the CQA engineer on a case-by-case basis *only* and will include restrictions on the equipment itself and on the type of movements the vehicle may make on the GCL.

The chemical nature of the cover soil must also be considered. The use of fine-grained, calcareous soil or stone is strongly discouraged due to the potential for an adverse reaction with the sodium bentonite contained in the GCL.

The cover material placed as backfill in the anchor trench should be of the same quality as the rest of the backfill. It is especially important that the anchor trench backfill be compacted either by hand tamping or by the use of a small walk-behind compactor. Compaction should be performed over each 150 mm lift of backfill placed in the anchor trench.

5.2 Geosynthetic Cover

A geomembrane or other geosynthetic liner system component is often placed over the GCL. Caution must be used during this activity to prevent GCL damage. Again, it is strongly recommended that no heavy equipment directly contact the GCL, but exceptions can be made on a project-specific basis.

A special precaution should be taken when textured geomembrane is installed directly over the GCL in a composite liner system. Because considerable friction may develop between the geomembrane and the GCL, it is difficult to pull the geomembrane into position for welding to adjacent sheets. A smooth "slip sheet" should be used to provide a low-friction sliding surface for the geomembrane until it is in position for welding.

SECTION 6
CONFORMANCE TESTING

Conformance testing is necessary in order to verify that the materials installed meet the requirements set forth in the specification. Although CETCO performs regular testing on its GCLs as part of its manufacturing QA/QC program, the engineer may require additional testing at the job site. This section lists several tests which may be utilized to verify the quality of the delivered materials and the quality of the installation of those materials.

6.1 Bentonite Mass Per Unit Area

A relatively simple test to verify that the specified amount of bentonite has been encapsulated in the GCL is to measure the bentonite mass per unit area of representative samples cut from delivered rolls. The results of this test may be used in conjunction with the results of the bentonite swell test described in Section 6.2 to arrive at an indirect verification of the hydraulic performance of the GCL.

ASTM D 5993 provides procedures for performing the mass per unit area test. After the correction for geotextile mass is made, there should be at least 3,800 g of bentonite contained within the GCL per square meter. This is CETCO's minimum average roll value (MARV) for bentonite content of all of its GCLs. These values are always subject to change, so please refer to GCL Technical Reference No. TR-404 for the most recent list of certified physical GCL properties.

If for any reason the resulting mass per unit area values do not meet the required MARVs, the corresponding rolls should be set aside for additional inspection and testing. CETCO should be notified to assist in resolving the problem if it persists.

6.2 Bentonite Swell

The swell capacity of the bentonite is one of the most important indicators of its ability to function as a barrier material. ASTM D 5890 provides a detailed free swell testing procedure used by CETCO. CETCO's MARV requirement for the bentonite is 24 mL/2g. As with the mass per unit area test described in Section 6.1, if this value is not achieved in conformance testing, the corresponding rolls should be set aside for additional inspection and testing. CETCO should be notified to assist in resolving the problem if it persists.

6.3 Other Conformance Tests

Other conformance tests may be conducted at the request of the on-site engineer or the CQA engineer. A commonly specified test is permeability (as per ASTM D 5084), although it should be cautioned that rapid "real-time" results are not possible due to the time required to achieve steady-state permeability values. Thus, it is difficult to use permeability testing as a pass/fail criterion for GCL acceptance at the job site.

Other tests can be used to evaluate the conformance of the bentonite component of the GCL. Although swell is an important indicator, the engineer may opt to perform further bentonite testing for such properties as fluid loss as per ASTM D 5891.

Lastly, it should be recognized that field-scale test pads and infiltrometer tests are typically *not* performed in GCL projects. This contrasts with compacted clay liner (CCL) projects, in which, for two reasons, field-scale data is almost always required. First, field data for CCL projects is necessary because there are many variables involved in their construction (compactor weight, speed, number of passes; soil type; moisture content; lift thickness; etc.). It is therefore necessary to build a test pad to ensure that the construction materials and methods intended for the project will provide the required level of performance.

Second, laboratory test results and field test results may vary significantly with CCLs due to the difficulties in retrieving representative, undisturbed samples. This factor also warrants that field data be obtained for CCL projects.

With GCL installations, however, there are very few construction-related variables. Additionally, the GCL that is tested for permeability in the laboratory is the *same* material deployed in the field. For this reason, a GCL such as Bentomat or Claymax does not require a field permeability test for every project.

SECTION 7
DOCUMENTATION

Thorough documentation of all CQA activities and tests is necessary in order to provide a written record that the GCL has been properly installed. The CQA documentation package for a GCL installation should include the following items:

- Bills of lading and corresponding packing list confirming receipt of all GCL installed at the site.
- A panel layout drawing in which the GCL roll numbers are keyed to their location in the field. Locations where damage was encountered and repaired should also be marked.
- The roll numbers from which samples were taken for conformance tests, along with the results of those tests.
- A daily report or diary of the activities undertaken at the site during construction.
- Certification that the requirements for the subgrade and for the cover material were achieved.
- A compilation of all CQA checklists completed during the installation.
- The manufacturing quality control (MQC) certification and accompanying test data.
- A description of deviations, if any, made to the original CQA plan during the installation.
- Photographs of the GCL during installation.

CETCO provides the MQC certification. All other items on the above list are the responsibility of the CQA engineer.

APPENDIX A

List of Applicable ASTM Standards

ASTM D 5887, "Standard Test Method for Measurement of the Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter," *Annual Book of ASTM Standards, Vol. 4.09*, American Society for Testing and Materials, Philadelphia, PA.

This method describes the specimen preparation, stress and gradient conditions, and testing procedures to be used for determining the flux (flow per unit area) through GCLs. Adherence to the specimen preparation procedures presented will help to minimize sidewall leakage, a common problem when testing thin barriers. This is an index test designed to determine product acceptability and uses a maximum confining stress of 35 kPa (5 psi) and a hydraulic gradient of 14 kPa (2 psi).

ASTM D 5888, "Standard Guide for Storage and Handling of Geosynthetic Clay Liners," *Annual Book of ASTM Standards, Vol. 4.09*, American Society for Testing and Materials, Philadelphia, PA.

This is a guide for the safe handling of GCL rolls at a job site, identifying the equipment and techniques typically employed to unload the material from delivery trucks and to place it in a dedicated storage area. Procedures are also presented for proper storage of the GCL in order to minimize the potential for product damage while in storage.

ASTM D 5889, "Standard Practice for Quality Control of Geosynthetic Clay Liners," *Annual Book of ASTM Standards, Vol. 4.09*, American Society for Testing and Materials, Philadelphia, PA.

Test methods and testing frequencies are presented for manufacturing quality control (MQC) of GCLs. This standard practice includes conformance tests to be performed on the GCL components (bentonite and geotextiles and/or geomembranes) as well as tests to be performed on the finished GCL product. Special procedures for GCL permeability/flux testing require the manufacturer to provide an historical database to demonstrate the consistency of the hydraulic performance of the finished product and to justify the reduced need for frequent MQA permeability testing.

ASTM D 5890, "Standard Test Method for Swell Index Measurement of Clay Mineral Component of Geosynthetic Clay Liners," *Annual Book of ASTM Standards, Vol. 4.09*, American Society for Testing and Materials, Philadelphia, PA.

This test method was adapted from the basic elements of a swell test presented in the USP/NF (United States Pharmacopeia/National Formulary). Two grams of dried and powdered bentonite are slowly dropped into a graduate cylinder containing 100 mL of distilled water. The swell value in mL is recorded after 24 hours, by reading the value on the graduate cylinder at the clay/water interface.

ASTM D 5891, "Standard Test Method for Measurement of Fluid Loss of Clay Mineral Component of Geosynthetic Clay Liners," *Annual Book of ASTM Standards, Vol. 4.09*, American Society for Testing and Materials, Philadelphia, PA.

This test method was adapted from the API (American Petroleum Institute) Procedure 13A/13B for bentonite. A bentonite slurry is created, aged, and then filtered in a pressurized cell. The amount of water passing through the filter cake in a specified time interval is recorded as the filtrate loss or fluid loss. The test indicates the clay's general ability to function as a barrier to liquids.

APPENDIX A (continued)

List of Applicable ASTM Standards

ASTM D 5993, "Standard Test Method for Measuring the Mass per Unit Area of Geosynthetic Clay Liners," *Annual Book of ASTM Standards, Vol. 4.09*, American Society for Testing and Materials, Philadelphia, PA.

This test method describes how to measure the bentonite mass per unit area of a GCL sample. A GCL specimen of a certain minimum area is weighed, oven-dried, and weighed again. The dry weight of the specimen, minus the nominal weight of the geosynthetic component(s), is then divided by the area of the specimen. The moisture content of the specimen is determined by subtracting the dry weight from the wet weight.

ASTM D 6072, "Standard Guide for Obtaining Samples of Geosynthetic Clay Liners," *Annual Book of ASTM Standards, Vol. 4.09*, American Society for Testing and Materials, Philadelphia, PA.

Presents procedures for obtaining representative samples of GCL material for laboratory testing purposes. These sample may be obtained either at the factory or in the field. Procedures for packaging and protecting the sample are also included to prevent the possibility of damage in transit to the laboratory.

ASTM D 6102, "Standard Guide for Installation of Geosynthetic Clay Liners," *Annual Book of ASTM Standards, Vol. 4.09*, American Society for Testing and Materials, Philadelphia, PA.

Provides detailed recommendations for the proper installation of GCLs. Discusses the necessary site conditions, equipment, and techniques for installing GCLs without damaging them. Includes recommendations on panel placement, overlaps, special considerations for slopes. Also discusses the preferred types of soil cover and equipment used to apply this cover.

APPENDIX B

CETCO GCL Construction Quality Assurance Checklist

Project Name/Number:_____

CQA Inspector:_____

Date:_____ Weather:_____

STORAGE AREA

_____ Rolls covered/tarped
_____ Rolls labeled
_____ No standing water present
_____ Packaging intact/repaired
_____ Accessory bentonite protected

INSTALLATION EQUIPMENT

_____ Core pipe straight
_____ Spreader bar straight
_____ Chains/Straps inspected
_____ Knife blades replaced
_____ Seaming clay supply available

MATERIALS RECEIVED TODAY

_____ Packaging intact
_____ Rolls inspected for damage--none found
_____ Damage suspected (indicate roll numbers and nature of damage _____

CONFORMANCE TESTING

Bentonite Mass/Area:

Bentomat Roll No.	Bentonite (g/sm)	Pass/ Fail?

Bentonite Swell:

Bentomat Roll No.	Final Swell Value (ml/2g)	Pass/ Fail?

SITE INSPECTION

_____ Subgrade surface acceptable
_____ Installation area dry
_____ Anchor trenches acceptable
_____ Design grades achieved
_____ Cover soil acceptable (as applicable)

INSTALLATION

_____ Number of rolls deployed today (attach list of roll numbers)
_____ Anchor trench fill compacted
_____ Min. seam overlap achieved
_____ All seams visually inspected
_____ Seam bentonite added (as applicable)
_____ All detail work inspected
_____ Downslope panel orientation
_____ All mat covered at end of day
_____ Storage area maintained

NOTES/OBSERVATIONS

NOTE: This checklist is intended to serve as a *guideline* for the CQA engineer to use in the development of a project-specific or company-specific CQA plan. The checklist is not all-inclusive. The items presented in this list are those that CETCO feels are the most important for the proper installation of Bentomat.

Attachment No. 6: GCLF_Caps_Spec

SECTION 4

FIELD CONSTRUCTION QUALITY CONTROL ACTIVITIES

WESTON developed a construction quality control plan (QCP) shown on the Closure/Post Closure Care Plan (C/PC plan) dated October 1995. Both the QCP and the C/PC plans are based on meeting the requirements of Chapter 391-3-4-.11, Closure Criteria, Georgia Department of Natural Resources for Solid Waste Management Rules. WESTON employed the manufactures Installation Guidelines and the Construction Quality Assurance document for the Geosynthetic Clay Liner (GCL) cap. These publications are presented in Appendix G. WESTON performed continuous oversight of all field activities to confirm that the closure construction activities were executed in general conformance with the QCP. The following specific items were performed to document the closure construction.

FINAL COVER SYSTEM INSTALLATION

The final cover system for the landfill cap consists of a compacted clay soil cap (CCS) and a Geosynthetic clay liner (GCL). The CCS cap consists of a 12 inch compacted bridging layer, an 18-inch thick compacted clay layer and 6 inches of vegetated topsoil. The GCL cap consists of a 9-inch thick bridging layer, the GCL and 14 inches of a vegetated cover. All geotechnical testing services required for the placement of the final cover system were performed by Willmer Engineering, Inc., Norcross, Georgia (Willmer). Willmer performed conformance testing for the bridging layer and the infiltration layer materials prior to and during their use in the construction of the soil cap. The results of this testing show that the materials used meet the intended function of the cap. These test results are available in Appendix C. Willmer also performed all in-place geotechnical testing to confirm the proper installation of the soil cap. The frequency and method of the conformance testing and the in-place testing are in accordance with Table 1 from the Guidance Document for Unlined Landfill Closure Criteria. All soil test locations can be referenced by the Geotechnical Soil Test Location Map shown in the beginning of Appendix D.

This map was developed by dividing the CCS cap area into 40,000 SF areas. These areas were subdivided into 10,000 SF areas which are identified with a sample identification on the Map.

COMPACTED CLAY SOIL (CCS) CAP INSTALLATION AND TESTING

The CCS is comprised of a 12-inch bridging layer, an 18-inch thick infiltration layer and a 6 inch thick vegetated cover. Willmer performed in-place moisture-density testing and in-place permeability testing to document the proper installation of the bridging layer and the infiltration layer. The bridging layer was installed in one 12-inch thick lift over the top of the compacted waste. The purpose of the bridging layer was to provide a stable base for the final cover system. In-place moisture-density testing (compaction) was tested at a frequency of one test per 10,000 SF using the drive ring method (ASTM D2937). The results of the bridging layer compaction testing show that in general this layer was compacted to greater than 92% of the maximum dry density as determined by a standard Proctor. Bridging layer compaction data for areas B-7, B-11 and some of C-11 is not found in the raw data. However, compaction and permeability data for the infiltration layer in these two areas supported by the Bridging Layer demonstrates that the maximum allowable permeability of 1.0E(-5) cm/sec has been met. In addition the total number of bridging layer tests is in excess of the total number required. The in-place moisture-density test results for the bridging layer are summarized in tabular form followed by the raw data from Willmer's daily reports in Appendix D.

The infiltration layer was installed in three 6-inch compacted lifts to achieve the minimum 18 inch thickness. Prior to full scale infiltration layer installation a test pad was constructed to in area C-10 to determine the successful installation method to achieve the required maximum allowable permeability of 1.0E(-5) cm/sec. The test pad data is available in Appendix D. Detailed information regarding all testing associated with the test pad is available on the field density work sheets submitted by Willmer daily for the months of August and September 1995. The field density worksheets are available in Appendix D. The in-place moisture-density (compaction) testing was performed using the drive ring method (ASTM D2937) at a frequency of one test per 10,000 SF per lift in accordance with the Quality Control Plan. The compaction

data confirms the proper installation of the infiltration layer. Complete compaction data for the third lift of area C-2, the second lift of C-4, the third lift of C-10 and portions of the first lift of D-1 are not found in the raw data. However the total number of compaction tests is well in excess of the total number required for the CCS cap. Additionally, the permeability test results of the lifts of infiltration layer material for these areas meets and exceeds the maximum allowable permeability 1.0 E(-5) cm/sec requirement. In-place permeability samples were obtained using the Shelby tube method at a frequency of one per 40,000 SF per lift and were tested in accordance with ASTM D5084. The results of this testing indicate that the permeability of the soil cap meets and exceeds the maximum allowable permeability of 1.0E(-5) cm/sec. The results of all in-place moisture-density and permeability testing are summarized in tabular form and followed by the raw data in Appendices D and E respectively. The infiltration layer was protected by placing a 6-inch thick lift of topsoil and seeding to establish the vegetative layer over the CCS cap.

GEOSYNTHETIC CLAY LINER (GCL) CAP CONSTRUCTION

WESTON provided continuous oversight for the installation of the GCL in accordance with the manufacturer's installation recommendations. A copy of the manufacturers installation guidelines are included at the beginning of Appendix G. The area of the cap where GCL was installed is outlined on the Final as-built drawing in Appendix J. The installation of the GCL is in accordance with the minor modification submitted to EPD. The modification for the GCL was also included on the October 31, 1997 submittal of the C\PC Plan which was approved on December 6, 1997. Two types of GCL were used in this area of the cap. A reinforced Bentomat GCL is installed in areas where the grades were between 10% to 25%. The Claymax 200R GCL is installed in the areas with grades less than 10%. All GCL materials certifications are located in Appendix G. The subbase below the GCL is comprised of the Bridging Layer material. This material was placed in a minimum 9-inch thick compacted lift to provide a suitable base for the GCL materials. Compaction testing on the GCL subbase is presented in Appendix D at the end of the bridging layer information. The installation of the GCL cap is in general conformance with the manufacturer's recommendations. The GCL was covered in one 14-inch lift and then seeded

to establish the vegetative layer. The thickness of the subbase layer and the cover layer are documented in the Soil Cap Thickness Verification Map and Table shown as Appendix F. The thickness of the subbase below the GCL was checked in three random locations as per WESTON's correspondence to the EPD dated April 9, 1997. The results of this check demonstrate that the minimum thickness of 9 inches was met.

MISCELLANEOUS FILLS

Construction of miscellaneous fills associated with the sedimentation ponds and the perimeter road was monitored for compaction using the Drive Ring Method (ASTM D2937). The results of the testing show that all structural fills were placed at a compactive effort of at least 92 percent compaction based on a standard proctor. The results are presented in Appendix D.

FINAL COVER SYSTEM THICKNESS VERIFICATION

The thickness of the CCS and the GCL cap components was confirmed by coring the cap on a one acre grid in accordance with the correspondence to the EPD dated April 9, 1997. EPD representatives observed the thickness check during the end of April 1997. Quality assurance representatives from W.L. Jordan also inspected all of the thickness checks on April 30, 1997. The results of this coring show that the minimum thicknesses have been met for all cap components. This information is presented on the Cap Thickness Verification Map and Table in Appendix F.

LANDFILL GAS COLLECTION SYSTEM

WESTON designed and provided oversight for the installation of the landfill gas collection system. The objective of the system was to upgrade the existing system of gas vents by the installation of a header system to route the collected gases to the flare house. An additional net work of header pipe has been installed below the cap for the potential of installing more landfill gas extraction wells. The flare house was upgraded to automate the existing system by providing

Attachment No. 7: Key Road Landfill (KRLF_Caps_Specs)

Waste Relocation and Daily Cover

Waste relocation was performed to flatten the existing slopes to accept the final cover system and to build up flat areas for positive drainage. Waste relocation was performed by exhuming waste with excavators and hauling it to the fill areas with articulated dump trucks. Based on historical records, test pits excavated across the site, and the inspection of waste during closure construction activities, the waste material consisted of municipal solid waste as identified in the permit (see Appendix A). Waste was placed in two-foot thick lifts and compacted prior to placement of subsequent lifts. Survey control was continuously maintained to control design grades in the cut and fill areas.

Throughout the waste relocation activities, the site was graded to avoid ponding and to promote positive drainage of run-off to sedimentation and erosion control structures. An odor control system was set up and maintained along the perimeter of the landfill to minimize the migration of odors to adjoining properties.

Daily cover materials for the cuts and fills was comprised of clean soil placed in six-inch thick layers. The cover materials was a virgin soil imported from the Prison Farm borrow area. Daily cover was started at such time in the workday to be completed before dusk.

Bridging Layer Installation

The bridging layer was placed as the finished top of waste grades were met. The top of waste grades were maintained continuously by a full-time surveyor registered in the State of Georgia. The bridging layer was installed in one six-inch thick compacted lift. All of the soil material used for the bridging layer was imported from the Prison Farm borrow area located adjacent to the landfill directly across Key Road.

Placement of the bridging layer was accomplished by spreading the soil material in an eight-inch thick loose thickness. The layer was compacted with heavy equipment to provide a stable

foundation for the infiltration layer. Compaction for the bridging layer in the areas of the cap covered with CCS cap was performed on a visual basis using loaded equipment as a proof roll to identify any unstable areas. Any unstable areas were undercut and replaced with suitable material to provide an unyielding surface for the CCS cap.

Compacted Clay Soil (CCS) Cap Installation

The CCS cap was installed over the majority of the landfill using the infiltration layer materials taken from the prison farm borrow area. The integrity of the infiltration layer was controlled by minimizing the work area, reducing the time to install subsequent lifts, and systematically placing the infiltration layer within the predetermined areas of no greater than approximately 40,000 ft^2 to optimize in-place sampling and production. The CCS cap was constructed in three six-inch compacted lifts to achieve the minimum required 18-inch thickness. The infiltration layer was placed by spreading the infiltration layer soil material with a dozer to an 8-inch thick loose lift. The layer of soil was then compacted and tested. Subsequent lifts were place immediately after testing to avoid desiccation cracking between lifts. Once the required thickness of 18 inches had been met, the 6" layer of topsoil was placed and seeded to protect the infiltration layer and establish the vegetative cover.

Geosynthetic Liner (GCL) Installation

GCL was installed over a 12.5 acre portion of the landfill area as shown on the As-Built drawing. WESTON and the independent quality assurance contractor provided oversight to insure that the installation of the Geosynthetic Liner Installation (GCL) was in accordance with the manufacturer's recommendation and guidelines. Two types of GCL were used in the cap; Bentomat and Claymax 200R. Bentomat was installed in areas with grades between 10% to 25%, and Claymax 200R was installed in the areas with grades less than 10%. After the GCL was deployed it was covered the same day with an 18-inch thick layer of cover soil materials. This soil

material was imported from the Prison Farm borrow area. The top of this cover soil was seeded to establish the protective vegetative cover.

The thickness of all soil layers comprising the final cover system were checked during the construction activities. The thickness of the vegetative cover, infiltration layer and GCL cover were confirmed during the final soil cap thickness verification check performed by WESTON and an independent quality assurance contractor. This thickness verification is presented in detail in Section 4 of this report.

Gas Collection System Installation

WESTON provided oversight for the installation of the landfill gas collection system. Installation of the gas collection system was ongoing as the final cap system was being placed. The lateral header piping was installed prior to the cap installation, and the vertical wells were installed as areas of the cap were brought to finish grades. Pressure testing was performed on sections of the lateral header pipe to confirm proper installation. The flare station was set on a concrete pad and connected to the system. The system was connected to power and tested to balance the well field. All penetrations through the cap are sealed with a 30 mil PVC apron to minimize the potential for oxygen infiltration.

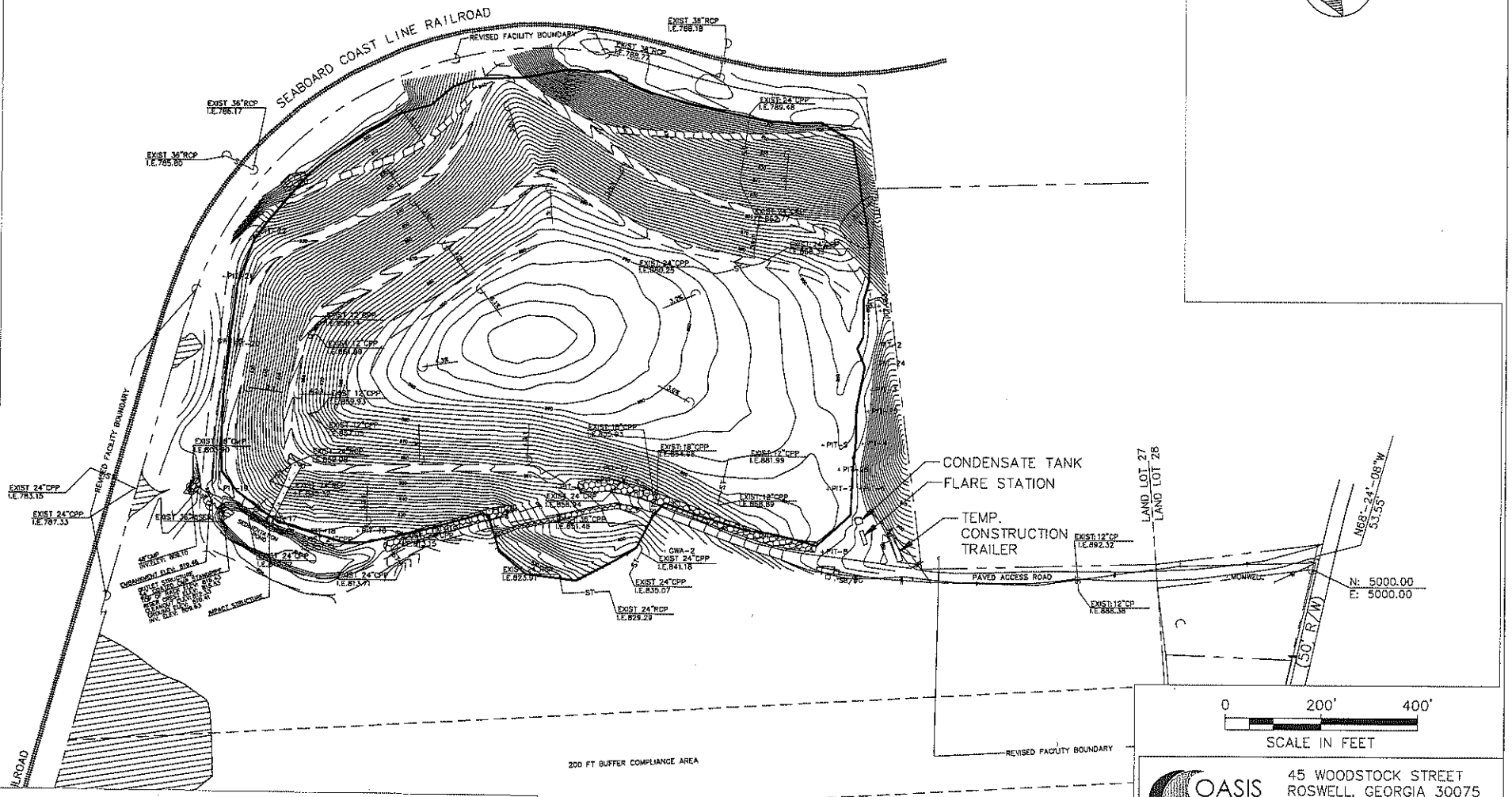
Landfill Gas and Groundwater Monitoring

WESTON performed the installation of the groundwater monitoring system and methane monitoring system. The groundwater monitoring plan and the methane monitoring plan were presented in a report that was submitted to EPD in September 1998. Certification of these systems is presented under separate cover.

Attachment No. 8: CASCADE_TOPO

(PLEASE DOWNLOAD TOPO MAPS FROM THE CITY'S WEBSITE FOR MORE DETAIL)

CITY OF ATLANTA
CASCADE ROAD LANDFILL



NOTES:

1. SITE BASE MAP BASED ON A DRAWING PRODUCED BY CH2MHILL TITLED "FIGURE 2 – METHANE REMEDIATION PLAN, EXISTING SITE PLAN" DATED 19 JUNE 2009.

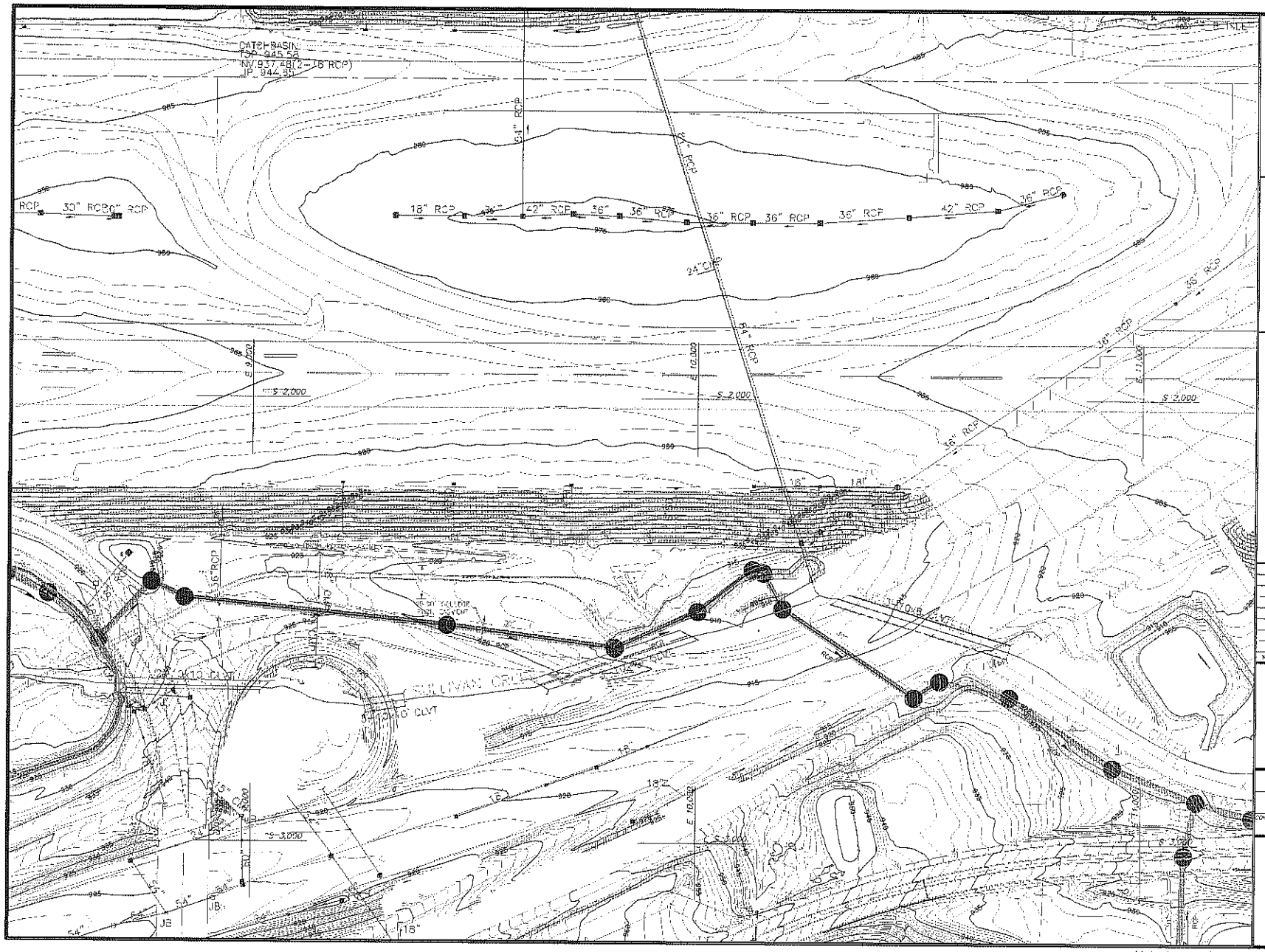
OASIS CONSULTING SERVICES
45 WOODSTOCK STREET
ROSWELL, GEORGIA 30075
PHONE: (678) 739-2400
FAX: (770) 552-5550

DATE:	4/25/12	SCALE:	1" = 200'
PROJECT NO.	11-1935-10	FILE NO.	12-2235F001
DOCUMENT NO.		FIGURE NO.	1

Y:\SHARED\APPLIED\CADD\PROJECTS\CITY OF ATLANTA\11-1935-10 CASCADE RD\DRAWINGS\12-2235F001

Attachment No. 9: GUN CLUB _TOPO

(PLEASE DOWNLOAD TOPO MAPS FROM THE CITY'S WEBSITE FOR MORE DETAIL)



CITY OF ATLANTA, GEORGIA

Hartsfield-Jackson Atlanta International Airport

DEPARTMENT OF AVIATION
PLANNING & DEVELOPMENT

NO.	DATE	BY	REVISION

EXISTING AIRPORT UTILITIES

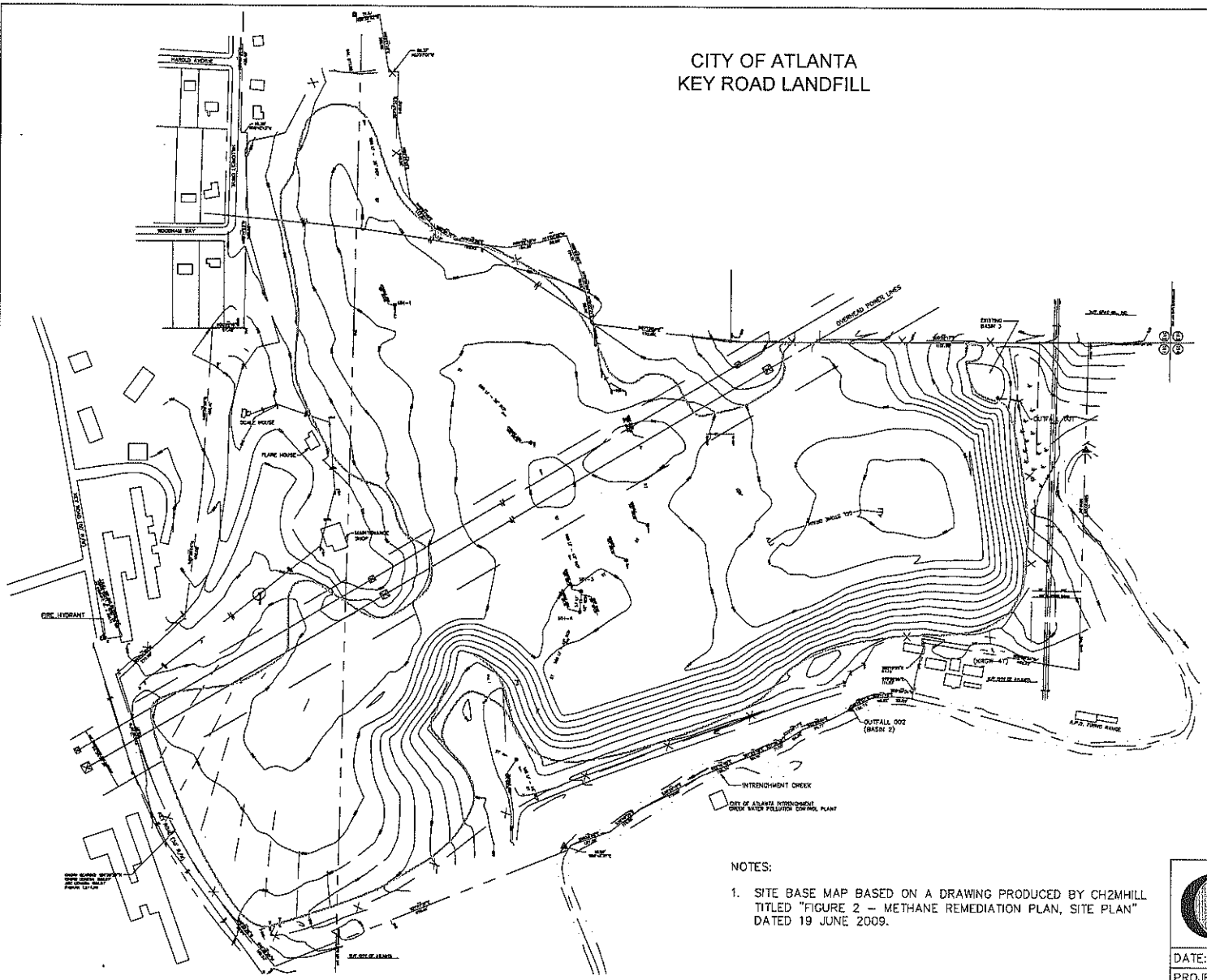
ABS NUMBER:	DRAWN BY:
FC NUMBERS:	DESIGNED BY:
CONSULTING PROJECT NUMBER:	CHECKED BY:
	APPROVED BY:
	DATE: FEB. 10 2014
	SCALE: 1" = 100
	SHEET NO: EX-1

g:\facilities\engineering\y gardner\hsh drawings\riverdale rd utilities (02-07-14).dwg

Attachment No. 10: KEY ROAD_TOPO

(PLEASE DOWNLOAD TOPO MAPS FROM THE CITY'S WEBSITE FOR MORE DETAIL)

CITY OF ATLANTA
KEY ROAD LANDFILL



NOTES:

1. SITE BASE MAP BASED ON A DRAWING PRODUCED BY CH2MHILL TITLED "FIGURE 2 – METHANE REMEDIATION PLAN, SITE PLAN" DATED 19 JUNE 2009.

0 300' 600'

SCALE IN FEET

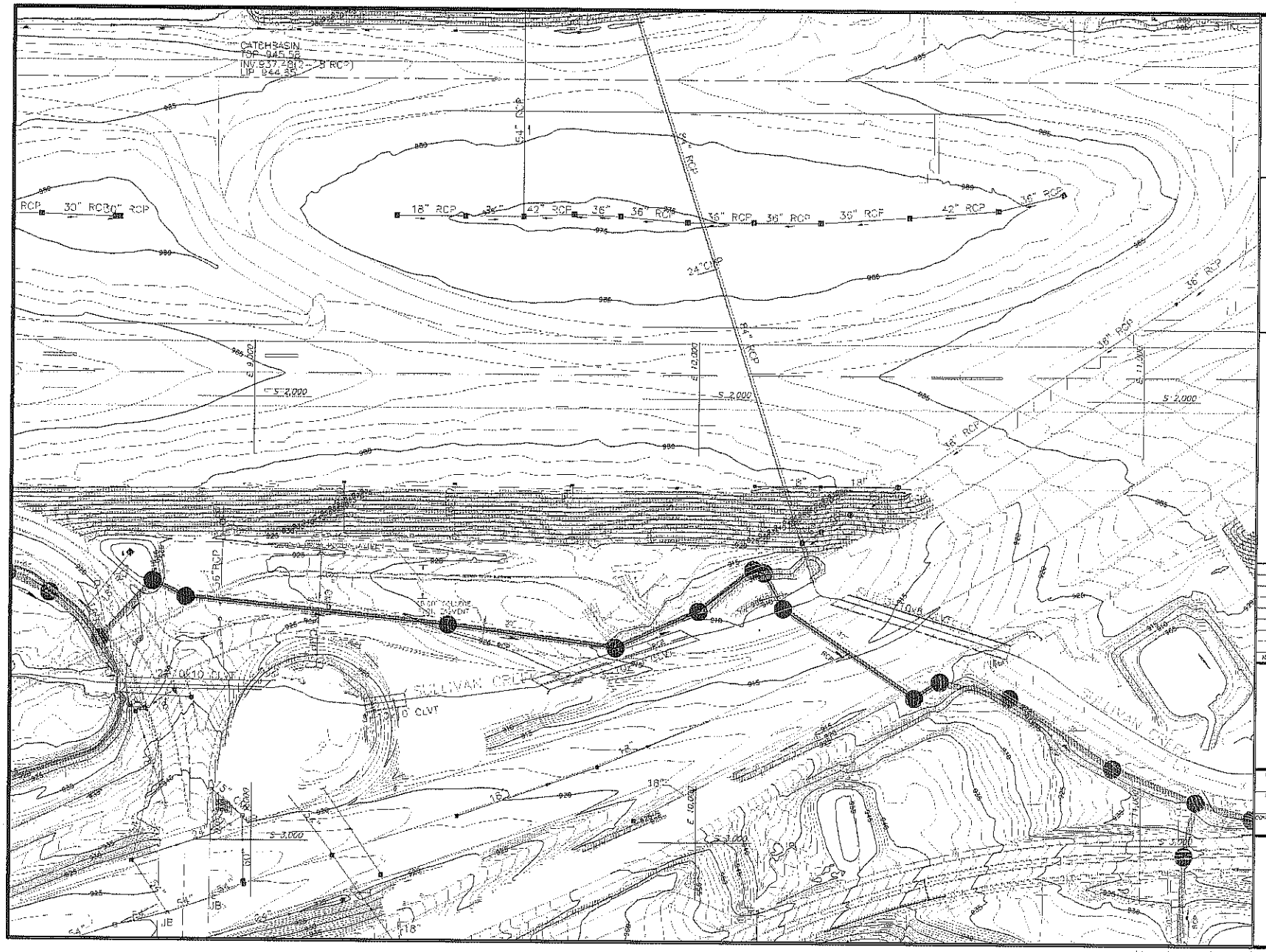
OASIS CONSULTING SERVICES
45 WOODSTOCK STREET
ROSWELL, GEORGIA 30075
PHONE: (678) 739-2400
FAX: (770) 552-5550

DATE:	6/15/12	SCALE:	1" = 300'
PROJECT NO.	11-1938-10	FILE NO.	13-2938F001
DOCUMENT NO.		FIGURE NO.	1

Y:\SHARED\APPLIED\CADD\PROJECTS\CITY OF ATLANTA\11-1938-10 KEY RD\DRAWINGS\13-2938F001

Attachment No. 11: Airport Utilities (03-11-14)-100' Scale.

(PLEASE DOWNLOAD TOPO MAPS FROM THE CITY'S WEBSITE FOR MORE DETAIL)



CITY OF ATLANTA, GEORGIA

Hartsfield-Jackson
Atlanta International Airport

DEPARTMENT OF AVIATION
PLANNING & DEVELOPMENT

NO.	DATE	BY	REVISION

EXISTING AIRPORT UTILITIES

HDR NUMBER:	DRAWN BY:
FE NUMBER:	DESIGNED BY:
CONSULTANT PROJECT NUMBER:	CHECKED BY:
	APPROVED BY:
	DATE: FEB. 10, 2014
	SCALE: 1" = 100'
	SHEET NO: EX-1

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